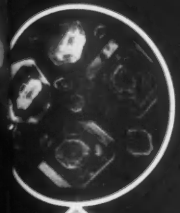
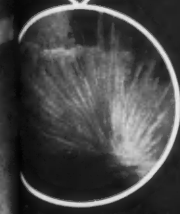
CHEMISTRY





DECEMBER
1959

HOW TO MAKE DIAMONDS

	Page
On the Back Cover	1
How Big is a Molecule? — STS Project	4
Apparatus — The Duo-Spectranal	5
Chemistry Quiz	8
Helium — The Sun Element	10
Penetrating Earth's Interior	11
A. P. I.: Organizational	16
For the Home Lab: Tannic Acid	19
Amateur Rocketry Blasts Off	22
Analytical Chemistry	24
Coffee — Natural or Synthetic?	28
Chemical Patents	32
Proudly Presented	34
Chemistry Comments	43
Book Condensations	47
	48

Editorial:
Many Tongues
Inside Front Cover

50¢

A SCIENCE SERVICE PUBLICATION

Many Tongues

➤ SCIENCE is the most truly international field of endeavor in the history of mankind. The political, religious, and nationalistic barriers dividing the peoples of the world are becoming of secondary importance, and there has in recent years been more international cooperation through scientific exchange than any other single channel.

If world peace can, as many people think, only come through the breaking down of these barriers, then our best hope for world peace rests in science.

However, progress has always been hindered by the language barrier. We find in the history of science many examples of independent discovery of the same fact by different scientists, often in different years, due to the fact that they wrote in different languages and were unaware of each other's work. This is happening today, even among the scientists of the free world where scientific exchange is encouraged, resulting in wasted effort through duplication. The mass of scientific literature continually published is too vast for efficient translation and distribution in a short time.

Interlingua is a possible solution to this problem. It is a simplified, natural, "average European" language, readily readable by most educated persons without prior study. It has proved of great value in abstracts in over a score of medical journals, and in several medical congresses.

However, Interlingua is an auxiliary language, and while it shows great promise for the future as a communicative, it will not obviate a knowledge of modern languages for the scientist.

The science student should not therefore neglect the study of languages in his training. Any research scientist without some knowledge of Russian, and preferably also German and French, is going to be severely handicapped.

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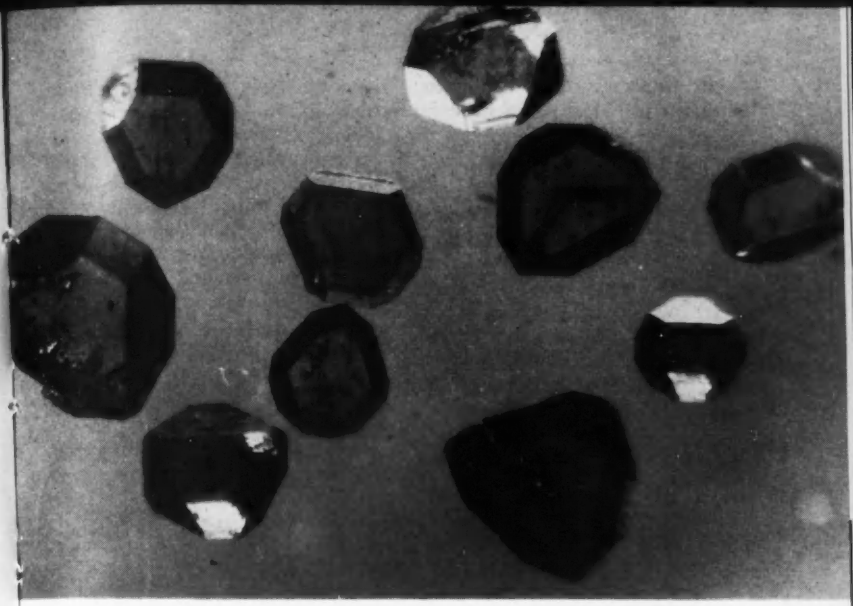


How to Make Diamonds

For the past 125 years man has been trying to make synthetic diamond. The first practical method, perfected in 1955, is here described for the first time.

▶ The General Electric Research Laboratory has revealed the details of one of its major scientific and engineering achievements, the process for making diamonds. Man-made diamonds, the climax of a 125-year effort to duplicate nature's hardest and most glamorous substance, were first announced by the Laboratory in 1955. (See CHEMISTRY, March 1955.)

Of the proper size for many industrial uses, less than a tenth of a carat, these diamonds have been sold in commercial quantities since October, 1957. Until recently, however, the unique process has been covered by a U. S. Government secrecy order.

The United States uses more than two tons of diamonds for cutting, grinding, and polishing each year, and there are no important domestic sources of natural diamonds. With the large-scale production of man-made diamonds achieved by the Company, the secrecy restrictions have been removed.

The essential breakthrough that enabled scientists to transform carbon

into diamonds was the use of a molten metal catalyst which acted as a thin film between the carbon and the growing diamond crystal.

Without the catalytic action, it is estimated that pressures of three million pounds per square inch and temperatures of over 7000° F would be required to transform carbon into diamond. There is no equipment in existence that could produce such a combination of sustained pressure and temperature.

Geological evidence has long suggested that natural diamonds were formed when carbon underwent extremely high temperatures and pressure deep within the earth. But the details of this rare process were unknown. For four years a group of scientists in the Chemistry Research Department of the General Electric Research Laboratory, under the direction of Dr. A. L. Marshall and A. J. Nerad, investigated many combinations of materials, pressure, temperatures, process times, and catalysts. They also constructed various pressure chambers that extended the capacity of high-pressure and high-temperature apparatus.

Finally, through cooperative effort on the part of Drs. Francis P. Bundy, H. Tracy Hall, Herbert M. Strong, and Robert Wentorf, a system for making diamonds was evolved.

In this system carbon and a catalyst metal are placed in a pressure cell and are subjected simultaneously to pressures ranging from 800,000 to 1,800,000 pounds per square inch and temperatures ranging from 2200 to 4400 degrees Fahrenheit.

The nature of the starting material used to supply the carbon has some effect on the kind and number of the diamonds formed. The best results are obtained with substantially pure graphite. Other carbonaceous material, such as carbon black, sugar charcoal, or carburizing compound, may be used as the source of carbon, but graphite is preferred.

The catalyst metal can be chromium, manganese, iron, cobalt, nickel, ruthenium, rhodium, palladium, osmium, iridium, or platinum. Tantalum is particularly effective for inducing the growth of small diamond crystals, although under some circumstances it may not be as active as the other catalysts.

The General Electric scientists also discovered that new diamond can form whether diamond seed crystals are present or not, and that the diamond can grow at very high rates. The formation of man-made industrial diamonds (80 mesh and finer) is completed within a few minutes.

Progress in the industrial applications of man-made diamonds has been most rapid. Early in 1955 twenty-five carats produced by apparatus in the Research Laboratory were used in abrasion tests and it was demonstrated that man-made diamonds would perform as well as natural diamonds. Soon after, a man-made diamond wheel was tested for comparison with natural diamond wheels and proved to be superior. Subsequent tests and actual use in production proved the superiority of man-made diamonds over natural diamonds in vitreous as well as resin bonded wheels for a number of different uses.

Of particular significance was the discovery that the shape of the dia-

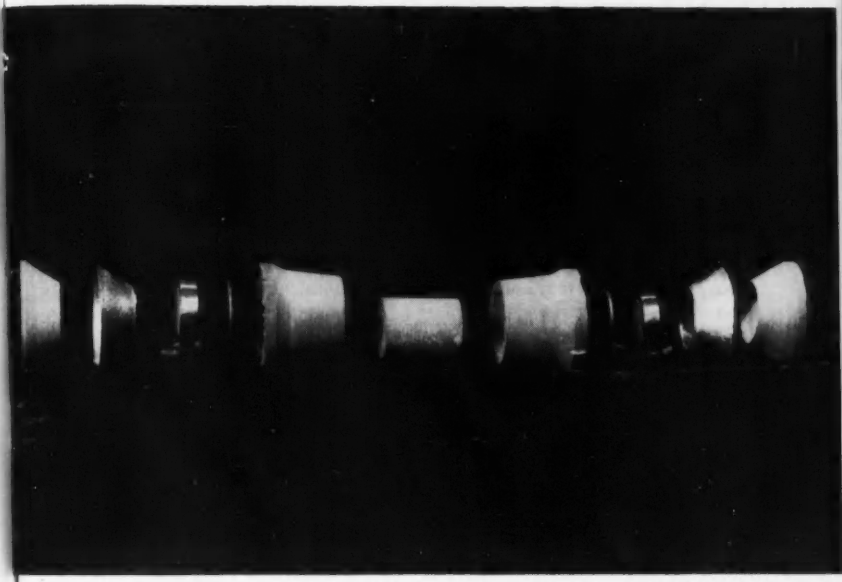
mond crystal varies according to the temperature of formation. Cubes predominate at the low end of the critical temperature range; mixed cubes, cubo-octa-hedra, and do-decahedra at the intermediate point; and octahedra at the upper limits of the range.

By controlling the shape and other characteristics of the diamonds it will be possible to tailor them more nearly to the requirements of industry for special cutting, grinding, and polishing applications.

Color was also found to be governed by the temperature of formation, varying from black at low temperatures through dark green, light green, and yellow to white at the highest temperatures.

Although many of the physical characteristics of natural diamonds can be duplicated at will, the small size of the man-made diamonds keeps them within the range of industrial rather than gem stones.

Several devices were invented by the General Electric scientists for sustaining the ultra-high pressures and temperatures required to change carbon into diamond. One very successful device, called the "belt" by H. T. Hall, its inventor, makes use of conical, Carboloy cemented-carbide pistons that push into each end of a specially



➤ AN "EXPLODED" VIEW *of the sample assembly showing the holder for the graphite and metal catalyst (center) and the components of the gasket and current-transmitting element (right and left).*

doughnut or "belt" shaped Carboloy cemented-carbide chamber. The conical piston has much greater strength than the usual cylindrical piston of high-pressure equipment. Both chamber and pistons receive support on all sides from a doughnut-shaped structure consisting of several stressed binding rings, from which this device takes its name.

A very important feature of the "belt" is its pressure sealing technique. In this technique, conical gaskets of pyrophyllite, a naturally occurring form of aluminum silicate, are used for the dual purpose of holding pressure and yet allowing motion through compression and flow. A unique characteristic of pyrophyllite is that its melting point is raised from 2400 to 4800 degrees Fahrenheit by pressure. Pyrophyllite is also used to hold the sample, which consists of the graphite and the metal catalyst. The high temperature is obtained by the passage of electrical current through the sample. The pyrophyllite, in addition to transmitting the pressure of the converging pistons, serves as a thermal and electrical insulation, enabling the pistons to remain comparatively cool, thus increasing their effective strength and extending their useful life.

The making of diamonds is of particular significance as the first major achievement in the commercialization of a superpressure process. It has also removed the possibility of the exhaustion of the world's diamond supply, and unexpectedly, has shown that man-made diamonds surpass natural diamonds for various industrial uses.

On the Back Cover

➤ Our back cover *shows Henry C. Wohlers of the Stanford Research Institute, California, with a solar furnace whose purpose is to concentrate not heat but light.*

Industrial photochemical reactions require a cool source of ultraviolet and visible light. At present, fluorescent light is commonly used in such cases. However, fluorescent sources emit almost all of their energy in the unusable, infrared region. Some heating occurs, and this is undesirable in certain reactions.

A novel research program developed by physical chemist R. J. Marcus and senior analytical chemist Henry Wohlers uses the solar furnace as a source of concentrated light (rather than heat). In their experiments they focused light from the furnace into an area enclosed by cooling coils, so that temperatures as low as 50 degrees Fahrenheit can be maintained. Thus far the technique, which was developed under sponsorship of Air Force Cambridge Research Center, has been used for the photoreduction of ceric ion with good results.

One possible use for the method may be in chemical conversion of solar energy. Present methods are slow and inefficient, in that large areas of exposure to sunlight are necessary, or else the reactants must be continually pumped through the exposure area. Concentration of the sunlight via the solar furnace probably would increase the total amount of conversion, thus resulting in substantial economies.

Science Talent Search
Project Report

How Big is a Molecule?

by EUGENE L. JARRETT
St. Albans High School, St. Albans, West Virginia
Eugene L. Jarrett, 16, received an honorable mention in the 18th Science Talent Search. He hopes to qualify in Chemical Engineering and to work in that field.

➤ THIS ESSAY is a description of an experiment in which I am very much interested. Making use of this, I plan to determine experimentally the size of molecules of various substances. Using the data from the experimentation, I plan to refine it and apply it with other data toward the construction of a project for the Regional Science Fair. This essay is a study of the process and how I plan to use it. It is not a review of former experimentation but is my plan for future experimentation concerning this process in which I have become recently but strongly interested.

The experiment consists of placing a known quantity of a substance on the surface of water and measuring the area of the layer which it forms. If reasonably pure conditions are maintained, the substance, a liquid having appropriate properties will spread out on the water in such a manner that the layer will be uniform, and the molecular monolayer will, if conditions are right, form a circular right cylinder with a height equal to the length of a molecule of the substance. This is due to the properties that the substance must have in order to be suitable for the experiment. Firstly, the substance must be a liquid which forms a mono-molecular layer in the manner described above. The substance and water must be immiscible. Secondly, the molecule must be an elongated one, or, at least, this is advantageous to the successful conduction of the experiment and makes possible more accurate calculation. Thirdly, the substance must have those properties which tend to make the molecule stand on end when placed on water. That is an attractive force which one end of the molecule has for the water.

Making use of knowledge of these properties, one can determine experimentally the length of a molecule. Since the exact quantity of liquid is known, using the formula for volume of a right circular cylinder one can determine the height of the prism by dividing the area of the base, in this case, the area of the mono-molecular layer, into the volume of the prism, in this case, a right circular cylinder. The height thus obtained is the length of a molecule of the substance.

In preparing for the actual experiment extreme cleanliness must be observed. The tray which is to hold the water must be perfectly clean and free of particles which might lessen the accuracy of the experiment. The tray must be washed carefully with a synthetic soap and rinsed carefully several times. Thus prepared, the tray is filled with clean water. The other

containers, for the substance, and for its solutions, if any are needed, must also be carefully cleaned as must a burette, a graduated cylinder, and an eye-dropper.

This being done the substance is prepared for use. The liquid is diluted with a water soluble substance because one drop of most pure liquids would form a mono-molecular layer, much too large for the laboratory.

On the surface of the water an indicator is placed which will define the outline of the mono-molecular layer. A drop of oil placed on the surface will form a layer on the water which is pushed aside as the liquid spreads out. Or in place of oil, some light powder may be used which will perform the same function.

This being done, a drop whose volume has already been experimentally determined, and from this the quantity of the substance contained in the drop mathematically ascertained, is placed in the middle of the surface of the water. The drop will spread out into its mono-molecular layer, the area of which may be determined from the formula for the area of a circle. The layer will have a circular surface or a surface shaped closely like a circle if the experiment is performed correctly. If, however, the surface is not circular and the approximate area cannot be determined, it is best to repeat the experiment, varying the quantity of substance or the indicator.

When this has been done, divide the volume of the substance, which has been determined experimentally beforehand, by the area of the surface of the mono-molecular film. The quotient thus obtained will be the experimental value of the length of the molecule.

I have stated that this is a plan for experimentation rather than a review of results already obtained. I should, however, like to include a report of the first of my attempts to perform this experiment.

The tray which I used was a photographic tray of plastic. I washed it carefully with a detergent solution, rinsed it, and filled it with clean water. Having no burette I used a graduated cylinder for the preparation of a solution of oleic acid U.S.P. in isopropyl alcohol. I used oleic acid because it has the properties before mentioned and alcohol because it will dissolve oleic acid and is soluble in water. I diluted the acid with alcohol to give a solution of 1% acid to 99% alcohol. I diluted 2 cc. of this solution with 8 cc. of alcohol, giving me a .2% solution of oleic acid in alcohol by volume. Thus a cubic centimeter of alcohol-oleic acid solution contained .002 cc. or 1/500 cc. of oleic acid. I found experimentally that 45 drops of the solution, when dropped from the medicine dropper that I used, had a volume of one cubic centimeter (cc.). Therefore each drop had a volume of 1/45 cc. and contained 1/45 $\times$ 1/500 or 1/22,500 cc. of oleic acid.

The indicator presented to me a problem. Oil (the oil I used was from the crankcase of my lawnmower) was unsatisfactory. Most powders that I tried were either soluble in water, too heavy, or unsuitable because they retarded, hampered, or made irregular the film which the oleic acid formed. Finally I found a baby powder that was suitable. I also found that the small bubbles formed when an emul-

sion of mineral oil in alcohol is poured over the surface of the water were suitable but limited in length of time of effectiveness since the small bubbles soon draw together.

Using both indicators (one per attempt) I twice placed a drop of the solution on the surface and both times calculated the area to be about 78.5 sq. cm. Dividing 1/22,500 cc. by 78.5 sq. cm., I obtained a quotient of 1/1,770,000 cm. or about .00000058 cm., which was my determined experimental value for the length of a molecule of oleic acid.

This experiment, however inaccurate it may be because of imperfect conditions or for other reasons, illustrates the order of the size of a molecule and shows that results can be obtained using the simplest of apparatus.

➤ "I WANT *something that will stop a nuclear physicist in his tracks!*"

The Duo-Spectranal

This is the first of a series of articles on new apparatus in the chemical field. Following up on the editorial in our October issue of CHEMISTRY, in which we commented on the trend towards mechanization in chemical techniques, we intend to present each month an example of modern instrumentation in the laboratory.

➤ THERE ARE SCORES of uses for a portable spectroscope that can not only supply a quick *qualitative* analysis for the common metals and a number of other elements but can be used for *semi-quantitative* analysis as well.

The Duo-Spectranal is used for a quick qualitative and quantitative check of soils, water, ores, minerals, alloys, inorganic and metallo-organic compounds, biological materials, the hemoglobin spectrum, pharmaceutical raw materials, drugs, foods and other products. It does in minutes what would take hours or days by conventional "wet" chemical methods.

The instrument shows the operator two spectra, that of the unknown and that of a comparison solution, side by side. An illuminated scale, graduated directly in angstrom units, can be projected beside the spectra and the wavelength of any line read to ±5A.

A Grating Spectroscope

The Duo-Spectranal owes much of its sensitivity and convenience to a feature ordinarily found only in far more expensive instruments: it forms the spectra of the sample and comparison solutions with *a replica diffraction grating* ruled with 31,070 lines per inch. Dispersion: 55A/mm. Viewed through the 5-power adjustable eyepiece, lines as close as 3A are easily resolved.

Unlike a prism, a grating gives a linear spectrum. This makes it possible to have an accurately pre-calibrated wavelength scale, reading directly in Angstroms.

The two sources, unknown and comparison sample, are automatically aligned when the sample is slipped in place. Each sample tube is enclosed in a water-jacket and sealed by a Lucite plug holding a pair of precisely-positioned platinum electrodes. Most samples are dissolved in 10% nitric acid solution.

The spectroscope slit "sees" both

➤ THE FISHER DUO-SPECTRANAL *expedites analyses of metals in soils, water, ores, minerals, alloys, inorganic and metallo-organic compounds, biological materials, pharmaceutical raw materials, hemoglobin, drugs, and food products.*

sets of electrodes. The two beams of light from the slit are focused on the grating and dispersed into two spectra, located side-by-side in the field of a Ramsden-type eyepiece. A neoprene eye-shield insures accurate comparisons, even in a lighted room.

By turning a scanning knob on the instrument, the operator sweeps spectra and scale across the field of the eyepiece, to study any section.

An Oxy-Hydrogen "Spark"

Oscilloscopic studies in the Fisher laboratories have made clear what happens in the Spectranal's patented source. What appears to be a sputtering spark at the "excitation" electrode is actually a rapid succession of microscopic oxygen-hydrogen explosions, intense enough to produce a flame-spectrum of the metals in the solution. The Duo-Spectranal thus provides the equivalent of an oxy-hydrogen flame without the need for gas cylinders, pressure regulators, needle valves or special burners, and without the tremendous evolution of heat.

The Duo-Spectranal occupies only a square foot of bench space, and is 9″ high. Its eyepiece is inclined at 30°, so that a seated operator can study the spectra comfortably.

The instrument's "set-and-forget" power supply, with an adjustable Powerstat regulator, uses a maximum of 250 watts on 115-volt 60-cycle a-c when starting (less in operation), and is fused for 1.6 amps.

Further information may be obtained from Fisher Scientific Co., 334 Fisher Building, Pittsburgh 19, Pa.

LIMITS OF QUANTITATIVE ANALYSIS WITH THE FISHER DUO-SPECTRANAL

Aluminum	15 ppm	Lithium	0.5 ppm
Antimony	20	Magnesium	0.5
Arsenic	250	Manganese	25
Barium	0.5	Mercury	100
Beryllium	50	Molybdenum	50
Bismuth	100	Nickel	25
Cadmium	15	Phosphorus	150
Calcium	0.5	Potassium	4000
Cerium	25	Rubidium	2000
Cesium	4000	Silicon	240
Chromium	5	Silver	15
Cobalt	50	Sodium	0.5
Copper	25	Strontium	0.5
Gallium	25	Tin	25
Gold	200	Titanium	15
Indium	10	Vanadium	50
Iron	10	Yttrium	10
Lanthanum	25	Zinc	5
Lead	150	Zirconium	25

√ *Chemistry Quiz* √

Directions: Mark the answer you think is *most nearly correct.*

Answers are on page 23.

A. Chlorophyll has been shown to have the quality of
   1. luminescence
   2. phosphorescence
   3. phototropism
   4. polymerization

B. At 10° C. a pound of magnesium occupies more space than a pound of
   1. aluminum
   2. ethyl alcohol
   3. nitrogen
   4. water

C. The best evidence to date indicates that the space between the stars is sparsely filled primarily with
   1. helium
   2. hydrogen
   3. oxygen
   4. tritium

D. In the symbol $_1H^1$ for hydrogen
   1. both numbers indicate atomic numbers
   2. both numbers indicate atomic weights
   3. the subscript number is the atomic number and the superscript number is the atomic weight
   4. the subscript number is the atomic weight and the superscript number is the atomic number

E. When moisture in the air passes directly from the gaseous to the solid state and forms ice crystals on a cold surface, this is called
   1. dew
   2. frost
   3. hail
   4. sleet

Complete copies (with answers and norms) of many previous Science Talent Search examinations are available at 15c each from Science Service, 1719 N St., N.W., Washington 6, D. C.

Radioactivity in South Pacific

➤ THE AMOUNT of radioactivity in the waters of the Pacific Antarctic is more than twice as great as the natural amount, according to a Russian scientist.

Mr. B. A. Nelepo of Moscow State University told the International Oceanographic Congress that this radioactivity was uniformly distributed over a vast area, indicating that the contamination was caused by the fallout of radioactive products from the atmosphere.

The measurements on which he based his results were taken last year in the south Pacific adjacent to the Antarctic continent east of the Balleny Islands.

The region of highest activity, he said, was found to be the upper mixed layer of ocean water, about 50 yards in depth. Radioactivity decreased considerably with depth in the layer between 50 and 150 yards.

Helium – The Sun Element

by Steve Hiscocks

Irreplaceable supplies of the second lightest element in the Universe, helium, are being rescued from natural gas in a new government program. The gas will be used in atomic reactors, in low temperature work, in welding, and in space experimentation.

➤ One of the great epics of the first World War was the discovery of helium in natural gas wells and its extraction as a non-inflammable gas to lift aloft airships and blimps. This use in aviation is now only one of many, and many new and more important uses have been found since 1918.

Helium has recently been in the news in connection with the opening of a new plant at Keyes, Okla., for the separation of helium gas from natural gases, of which helium comprises some 2%. This plant, costing $12 million, is designed to produce about 290 million cubic feet of the gas a year. The total production in the U. S. prior to the opening of this new plant, was from 344 to 350 million cubic feet per year, so that the Keyes plant will almost double the total output. This has enabled the voluntary allocation system, which has been in operation for the last sixteen months, to be lifted.

The demand for helium has increased five-fold over the last ten years, and is expected to increase even more. At present, large amounts of natural helium are lost when natural gas is burned as fuel. Accordingly the Secretary of the Interior, Fred A. Seaton, has proposed a national helium conservation program whereby up to 12 additional helium extraction plants would be built, either by industry or by the government, to remove the helium before the natural gas is piped for general use.

The production of helium by the four plants operating before the opening of that at Keyes was in fact just sufficient to satisfy the demand of the federal agencies under the restrictions at that time imposed, however, only about 75% did in fact go to these agencies so that everyone was short.

The present breakdown is roughly as follows:

Air Force. Helium is used in shielded arc welding, in electronics, and in the detection and sealing of leaks in missile components. In fact, helium finds many general uses in missile research.

Navy. Due to its lightness and stability, helium has always been an ideal gas for the inflation of balloons. It is used by the Navy in weather research and in submarine spotting especially.

Weather Bureau. Balloons are sent up all over the world in the study of atmospheric conditions. Of especial interest are the special high altitude balloons, developed by General Mills, which attain heights of up to twenty miles.

Atomic Energy Commission. At present the main use is in shield arc welding; however, it is here that one of the greatest future uses is antici-

pated. The U. S. does not at present have a gas-cooled atomic reactor in operation, but expects to have one in the near future. It is probable that helium gas will be used as the coolant. The gas has several properties making it especially suitable for this purpose. It is chemically and radioactively inert, it has good heat transferance properties, and has a very small nuclear cross-section. The gas-cooled reactors presently in operation in the U. K. employ carbon dioxide as the coolant, having no source of helium other than the U. S.

The National Bureau of Standards. Helium is here used in cryogenic research and in the growth of crystals. Another growing use of helium is in gas chromatography for which it is especially suitable because results will not be obscured by chemical reactions.

Commercial Users. Over the last eighteen months or so helium has been used by commercial concerns working under government or A.E.C. contracts. The specific uses are similar to those outlined above.

The production of helium in the U. S. began during World War I when it was required by England, for use in balloons. The only deposits in the Commonwealth are in Canada and were, at that time, spotty and unreliable, although fresh and better deposits have more recently been discovered in Saskatchewan.

Recovery

Helium is obtained from only gas wells where it occurs as a minor component of natural gases. Its concentration might be less than 1% although a few wells contain up to 6 or 8%. These wells are scattered over the Southwest States, the main ones being in the Texas and Oklahoma panhandle regions. Smaller sources of higher helium content are found in New Mexico and in Colorado.

The essence of helium recovery is low temperature crude extraction whereby at Keyes 90% pure helium is removed from the natural gas on the way to fuel markets. The gases are cooled to about — 185 degrees Centigrade (— 300 degrees Fahrenheit or 88° K), at which temperature most other constituents liquefy, by means of liquid nitrogen. Helium itself does not liquefy above about 4° K at normal pressures. The 90% pure helium is now passed through more heat exchangers for further rectifacation which brings it up to the order of 98% pure. It is finally passed through activated charcoal, maintained at the temperature of liquid nitrogen, and emerges with a purity of more than 99.995%.

History

The first discovery of helium (although not recognized as such at that time) was in 1868 when a scientist by the name of Janssen first made a spectroscopic examination of the sun's chromasphere, during a total eclipse. He detected a strong yellow line close to the D lines of Sodium. Franklard and Lockyer investigated this, and decided that this line must be due to a new element, then undiscovered upon earth, which they named helium from the Greek *hellios* meaning sun.

In 1894 Sir William Ramsay made his famous discovery of argon in the atmosphere. Some years previously an American chemist, Hildebrand, had obtained an inert gas in tests on a

uranium ore. Ramsay, suspecting that this might have been argon, sent for samples of the mineral and eventually succeeded in isolating helium which he proved spectroscopically to be a new element, identical with that discovered in the sun 26 years earlier.

Properties

The properties of helium are interesting and unusual in many ways. It belongs to group O in the periodic table, the "inert" or "nobel" gases, of which it is the first and lightest. Chemically it is a student's dream: it virtually has no properties. In common with the rest of its group, neon, argon, krypton and radon, it forms no stable compounds, and exists only in the monatomic state. This is because its outer (and only) electron shell is completely full, and has no tendency either to give up or accept electrons to form a chemical bond.

Helium is a completely odorless, colorless gas at normal temperatures. At about 4° K it condenses to a liquid, and at about 1° K this liquid condenses to a solid having the lowest melting point of any substance.

Liquid helium exists in two forms known as Helium I ("ordinary helium") and Helium II. Helium I exists above 2.17° K while Helium II exists below 2.17° K, and they do not exist together, as do the different forms of carbon, phosphorous, and sulphur, except at the transition temperature. These are very different. Helium II has been shown to have a heat conductance about three million times greater than that of Helium I, and several times greater than that of copper at room temperature. Another unique property of Helium II is that its viscosity appears to be virtually zero. Thus a small flask of Helium II will empty itself by the liquid flowing up the inside of the container, down the outside, and dripping off the bottom. Helium II forms a thin surface film over the glass which flows in any direction without friction.

A main use of liquid helium is in producing extremely low temperatures. Many substances show peculiar properties at low temperatures; for example, super conductance in which the electrical resistance of some metals reduces to practically zero. Since temperatures close to zero are found in outer space, this research is of some importance.

In the gaseous phase also helium exists in two forms, although of a rather different nature. These are called ortho and para helium, which is confusing because no direct parallel may be drawn with the well known ortho and para forms of *molecular* hydrogen. The difference between ortho and para helium lies in the electronic energy levels and results in two independent sets of spectral lines corresponding to the two types.

Helium gas has one property which makes it of use to non-scientists. Its solubility in water is very slight, and also it is very light. It is therefore used for mixing with oxygen to make "air" for divers and others who work under high pressures. Not only does this lighten the load on the diver, but it reduces the tendency towards "bends." This is the often fatal condition of divers when nitrogen from normal air has dissolved in their blood under pressure. On the release of the pressure the nitrogen forms bubbles in the blood causing great pain and often death. The same mixture of

helium and oxygen is also used in hospitals to relieve respiratory troubles, since it is easier to inhale.

What of the future of helium? Demand is expected to spiral, and if no further plants are built, it is estimated that a shortage will have developed again by 1963.

If helium is going to pay for itself, then the price is not going to go down. In fact it may even go up, and for this reason some users are turning to argon, another inert gas, for such uses as shielded arc welding. The price of argon, at present roughly the same as that of helium, is expected to go down. Thus some of the load may be taken off helium; however, the demand will certainly go up and eventually more plants, like that at Keyes, will have to be built if demand is to be satisfied.

Power System Would Work on Moon

➤ A NEW SYSTEM of generating powerful bursts of electric power has been devised that would work on the moon.

It could be used to supply power for transmitting beams of concentrated information by radio from the moon to earth, General Electric Company officials reported.

The new system has been successfully operated at the company's Philadelphia Aerosciences Laboratory, and produced about 1,000 watts of electric power for five seconds, reported Dr. Leo Steg, manager of the laboratory.

The electricity was produced by means of magnetohydrodynamics — called MHD for short. In this system, a high-temperature ionized gas in a magnetic field serves as a conductor, rather than wire. This eliminates moving parts, and may lead to future power generating efficiencies of 40% to 50%. Generating electricity through conventional turbo-generators is at efficiencies of about 35%.

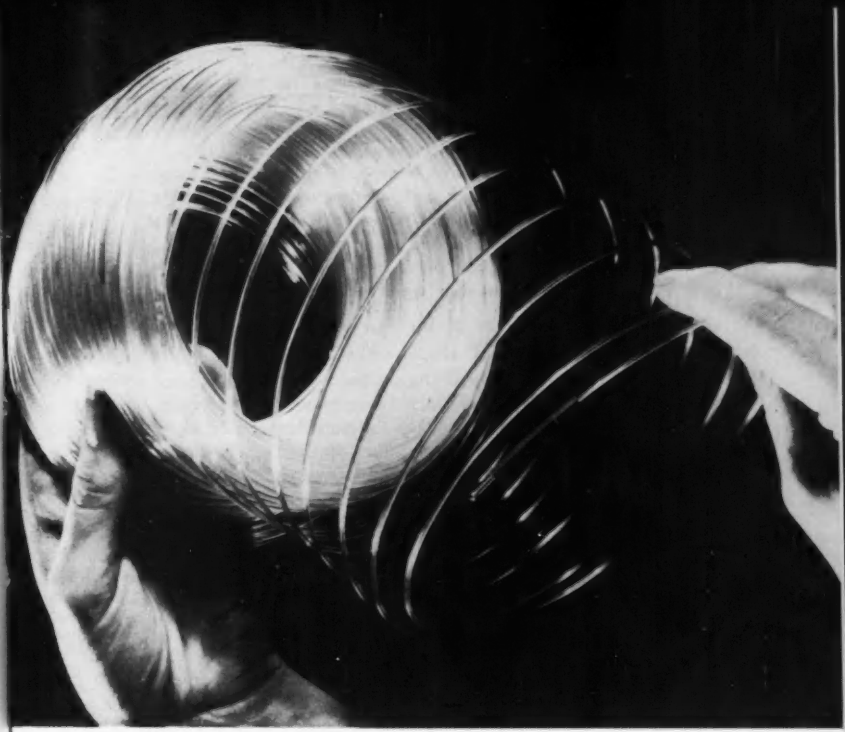
Improvements of the present crude device could be made that might lead to actual applications in two years, George Sutton, project engineer, believes. He envisioned the MHD generator coupled to a small solid fuel rocket which would supply the needed heat. Such a device could generate a 15-second burst of power under the moon's airless conditions.

The electric power would be strong enough to transmit heavily compressed information back to earth by radio, together with television-like images.

The development grew out of research directed at achieving lighter, more reliable and efficient power plants for space vehicles. As applied to a space vehicle, MHD power could be used to generate electricity either in a "closed cycle" to provide continuous electricity or an "open cycle" to provide short bursts.

In the closed system, solar or nuclear energy would be used as the heat source, and then ionized gas would be continuously circulated. In the open system, a small solid-fuel rocket motor would be used for heat.

Despite the high theoretical operating efficiency, the MHD system is not expected to supplant big turbo-generators for commercial power production here on earth in the foreseeable future, the company reported.



➤ COMPACT GLASS *coils up to 300 feet in length are being produced by Corning Glass Works for use in gas chromatography.*

The capillary coils are designed for high temperature resolution of compounds. They will not deteriorate or oxidize at temperatures up to 510 degrees Centigrade. Current usage is at maximum of 250 degrees Centigrade.

The smooth inside surface of the glass permits application of a thin, uniform grease coating required for effective resolution. The coils are treated to resist abrasion; heavy-walled for mechanical strength.

The coils are being made in lengths of one, two and three hundred feet with coil internal diameter of either 2 or 3 inches. Tubing internal diameter can be either .010 or .020 inches, while the outside diameter of the tubing is 1/16 of an inch for uniform size connectors. A 300-foot coil can be placed in a box 2 inches deep and 5 1/2 inches square.

Other bore sizes and lengths can also be made to meet specifications and aluminum holders are available for storing and handling.

Penetrating Earth's Interior

by Richard Litell

Scientists plan to drill a six-mile-deep hole through the crust of the earth and into the underlying mantle. They seek actual pieces of rocks from a region that flows but is solid to add meaning to decades of second-hand geological data. They also look forward to the chance of making significant unpredicted discoveries.

➤ Man is eagerly seeking more knowledge of what surrounds the earth in outer space but has hardly begun to probe the depths of his own planet. He has sent rockets to the moon and beyond but is not even sure of what lies six miles beneath the very ground he walks on.

Direct sampling of hitherto unreached regions of the earth's interior could supply answers to countless scientific questions regarding the age, history and composition of the earth. With this aim in mind, scientists are now planning to drill a six-mile-deep hole through the crust of the earth to the underlying mantle.

The earth's crust is a thin, slag-like covering of light rocks averaging 10 miles in thickness, a mere 400th of the earth's radius. Below the crust is a mantle and an inner core. Neither has ever been reached by man.

The mantle accounts for 80% of the earth's volume and is believed to be composed of a material similar to peridotite. The core is thought to be composed of a mixture of iron and nickel.

Between the mantle and the crust is a transitional layer known as the Mohorovicic (Mo-ho-ro-*vic*-ic) Discontinuity, commonly referred to as the Moho. Scientists know of the Moho's existence because seismic waves sent down through the crust experience an abrupt increase in velocity when they encounter this layer of chemical or physical change.

It is the Moho that scientists hope to penetrate by digging this deepest hole yet attempted by man. They will thus be able to tap the underlying mantle, whose exact composition is one of the most important unsolved problems of geophysics.

This hole will not be dug on land, however, because the earth's crust under the continents averages 20 miles in thickness, whereas under the oceans it averages only five miles in thickness. Thus, the Moho and mantle are far closer to the surface of the sea than they are to the surface of the land, even allowing for the depth of the ocean, which averages about two and a half miles.

The deepest hole yet drilled by man was a Texas oil well 25,340 feet (almost five miles deep). But this was drilled on land through a much thicker crust and the drills did not approach the mantle.

In charge of the Mohole Project, as the attempt to drill to the Moho is called, is the AMSOC (American Miscellaneous Society) Committee of the National Academy of Sciences — National Research Council. The en-

tire project, the Committee believes, can be successfully carried out within four years, provided the necessary $15,000,000 can be raised. Studies have found the project to be both feasible and highly desirable.

What little scientists already know about the structure and composition of the earth's interior has been arrived at only indirectly. They are now looking forward to a direct sampling of nature's cache of geophysical secrets.

Successful sampling of the sediments of the ocean floor, the earth's core, the Moho and the mantle can reveal the nature of marine organisms back through time and perhaps to the origin of life. It can provide clues to the origin and structure of the earth and add meaning to, or confirm, great stores of geological data accumulated during past decades. Sediments could contain an uninterrupted record of the earth's development for two billion years.

Shifts in locations of the earth's magnetic poles may be recorded in the orientation of tiny magnetic particles discovered in the drilling, and temperatures of the oceans at various times in geologic past may be revealed by biochemical studies of shells and chemical studies of calcium carbonate on ancient sea floors.

Conflicting theories on the nature and composition of many regions can be resolved and the opportunity will exist for possible unexpected discoveries to be made.

Though it is not believed a hole in the ocean floor a good distance from the continental shelf will uncover any rich oil deposits, the petroleum industry could profit from the experimental work of this project, which could lead to faster, better and cheaper techniques for deep drilling and coring.

The average depth to the Moho from the surface of the sea (seven and a half miles), though far less than from land, is still beyond the reach of present drills. But by seismic surveying techniques it is possible to locate thin places in the ocean basins where the total depth to the Moho is less than 32,000 feet, or about six miles. These depths are probably within reach 'if the best modern drilling equipment and technology can be assembled."

Two promising ocean sites have been investigated for the Committee thus far. One is in the Atlantic about 200 miles north of Puerto Rico, where the depth to the Moho is estimated to be 31,500 feet. Another is in the Pacific off Mexico between Guadalupe and Clipperton Islands. The latter now seems more promising but final site selection will not be made until after the first of the year.

The choice is a difficult one, for a favorable combination of many desired conditions must be sought. Weather and wave conditions must not hamper the work, the depth to the Moho must be small, the distance to a base of supplies must be short, the site must be truly representative of the crust in ocean basins, and an ample amount of sediment for coring operations must be present. Also a thorough knowledge of local current activity must be had to help solve the problem of maintaining a drilling ship's position. Directly above the hole a ship's position must not be permitted to vary in a radius of more than two percent of the depth of the wa-

ter (240 feet in 12,000 feet of water).

Preliminary work now under way includes studies of how an existing ship can be modified, exploration of promising sites and examination of promising ideas.

The first phase of the project will consist of modifying a drilling ship for deep-water operations. This ship will be used within 18 months to drill a series of preliminary holes not to exceed 18,000 feet in depth. This is to test equipment and obtain engineering design data.

Included will be comparisons of rotary, turbo and sound drilling methods, and testing of various coring devices.

Until such information is obtained by direct experiment at sea, no one knows how to proceed with the design of a rig that will be capable of reaching the mantle — over two miles deeper.

Stearic Structures of Tranquilizers

➤ TRANQUILIZERS may literally be umbrellas that protect the brain from a shower of stresses and strains.

Structurally, tranquilizers resemble atropine which is known to dry the mouth and stop intestinal movement, or curare, the Indian arrow poison that paralyzes muscles. All have large umbrella-like chemical structures which may shield the nerves from stimulating substances, Dr. T. C. Barnes, formerly of Hahnemann Medical College, Philadelphia, reported at a meeting of the American Pharmaceutical Association.

Dr. Barnes bases this explanation of tranquilizers upon the results of an experiment with neurotic mice. He found that one tranquilizing chemical, stelazine, was three times as powerful as thorazine in subduing the neurotic behavior of the mice. Stelazine has an added piperazine ring to the three-ring umbrella structure of thorazine, Dr. Barnes pointed out.

A good umbrella must have a handle, Dr. Barnes continued. In the phenothiazine tranquilizers, this essential part of the structure is a row of three carbon atoms. The nerve is accustomed to this handle because it is present on several natural neurohumoral agents such as adrenalin and histamine.

The newest umbrella tranquilizer is mellaril or thoridazine which has a four-ring structure like stelazine, but which lacks the essential "handle," the three-carbon chain. This may explain why it is so weak, the researcher speculated.

A mental patient may require a gram of mellaril where five milligrams of stelazine would do the job. An analogous situation would picture a person in a thunderstorm with a big umbrella and no handle.

In major epilepsy, the umbrella theory works very well, Dr. Barnes pointed out. All drugs used in severe fits have a phenyl or flat benzene ring structure which may have a protecting or screening effect. For example, phenobarbital is the only sleeping pill or barbiturate used in severe epilepsy, and moreover it has the only phenyl "umbrella" type of structure in this large group of drugs, he explained.

Another In Series on Chemical Organizations

A.P.I.

➤ The American Petroleum Institute, more familiarly known as API, celebrates its 40th birthday this year, coinciding with the Centennial anniversary of the oil industry itself.

API serves as clearinghouse and information bureau for the 12,000 individuals and companies who make up its membership. It cooperates with government and with associations and companies of related industries such as steel and automobiles. Through volunteer committees covering the wide gamut of industry activities, API serves as an educational forum aimed at stimulating petroleum progress.

The Institute was established in 1919 by a few score members of the National Petroleum War Service Committee who had assisted the Federal Government in organizing their industry to meet the tremendous fuel and lubrication demands of World War I. Since that time, thousands of oilmen have contributed to achieving cooperation in an industry known for the intensity of its competition.

A board of directors selected by the membership determines and guides API policy. There are five major divisions: production, refining, marketing, transportation, and finance and accounting. The major part of API work is conducted through hundreds of working committees and subcommittees. The continuing program of fundamental research provides an insight into API activities.

Thirty-three years and more than a million dollars have been spent on a research study of the hydrocarbon composition of a single barrel of crude oil. The project is being conducted by personnel of the Carnegie Institute of Technology in Pittsburgh, Pa.

The director of the project at Carnegie makes out his budget each year. It is checked by the advisory committee of the API Board of Directors, and a recommendation is passed on to the board. Once the budget is approved, the API has no control over specific expenditures.

To date, this project has produced 169 fully identified hydrocarbons. More than a million are estimated to exist.

The work, vital to an understanding of the nature of petroleum, continues to go forward.

This type or organizational structure, with outside professional personnel conducting the project under the eyes of a volunteer committee, is typical of API research programs.

Some recent projects of interest to chemists include the following:

Corrosion research into hydrogen attack on steel.

Investigation of iron-sulfur chemistry at temperature ranges from 500 to 1500 degrees Fahrenheit.

Determination of trace elements, important in the catalytic process.

Establishment of fellowship for collection and selection of data on

the physical constants of hydrocarbons in engineering units.

The chemistry of urban air pollution.

For these and all such programs, API serves as a sponsor, in most cases as the initiator — this in response to the urging of a group of oilmen. The success of the program is in large measure dependent upon the work and cooperation of the members of the industry, large and small, who make up the various committees.

The operation of the Division of Refining is typical of API divisional activity. Its general committee is composed of 75 members, 70 of whom are elected by enrolled members of the Division, five of whom are appointed by the API president from the board membership.

The platform of the Division serves as a technical forum at which papers on a variety of subjects of interest to refiners are presented, or at which committee and subcommittee reports on the results of sponsored research are heard.

There are eleven committees in the Division of Refining, including the general committee. Areas covered include refinery equipment, petroleum products, waste disposal, automotive research, analytical research, and training.

Reports by these groups are published and made available to both members and non-members of API.

Highlight of the year is the annual meeting, at which more than 6,000 members gather to attend scores of general and divisional sessions. Work in progress is reviewed and evaluated at committee meetings and programs are planned for the coming year. In addition, some of the divisions of API hold mid-year meetings, primarily for consideration of technical problems in their particular fields.

One of the outstanding achievements of API has been work leading to the standardization of petroleum equipment. It is estimated that this program saves the world oil industry more than $15,000,000 a year.

In addition to its own programs, individual members of the API participate in the activities of many trade associations and technical societies on matters of mutual interest. These include the American Society for Testing Materials, Manufacturing Chemists' Association and the American Society of Mechanical Engineers, to name a few.

The success of the Institute's varied programs is indicated by the wide recognition accorded the API monogram. Imprinted upon technical papers and books, public information films, equipment in the field, it signifies the rigid standards of high purposes of the organization's membership.

Bearings Lubricated by Air

➤ MANY BEARINGS are now being lubricated by air and other gases rather than oil. These gas-lubricated bearings, either externally pressurized or self-acting, have special advantages over liquid-lubricated bearings.

Among these advantages are the ability to withstand extremes of temp-

erature, absence of contamination, low friction, simplicity, quietness, reliability and long life.

Prof. Dudley D. Fuller of Columbia University, New York, told the First International Symposium on Gas Lubricated Bearings that gas bearings will be particularly useful for industrial and Government projects that require a wide range of operating temperatures.

A gas-lubricated bearing, he said, is one that has its rubbing surfaces completely separated by a film of gas, even when a load is applied to the bearing.

Such a bearing has present applications in precision grinders, turbo expanders, gas circulators, experimental rotors for closed-cycle gas turbines, air-cycle refrigeration machines, precision measuring instruments, elements of computing machines, gyros and similar devices. Developments are either contemplated or underway for units to operate at cryogenic (very low) temperatures as well as extremely high temperatures.

Gases are stable over a wide range of operating temperatures, Prof. Fuller said, and do not undergo changes of phase such as other lubricants, which melt, freeze, vaporize or decompose "between the limits of temperature that are presently considered for industrial service and for the national defense."

Applications are being contemplated from about minus 450 degrees Fahrenheit to about as high as 3,000 degrees Fahrenheit.

Because of the low friction of gas-lubricated bearings, high operating speeds become practical, he said. High-speed turbo-compressor units have been operated experimentally at 165,000 revolutions per minute and development work is under way for a small high-speed grinder to operate between 400,000 and 500,000 rpm.

Collapsed Atoms in Dwarf Stars

➤ WHITE DWARF STARS, which have densities so high a cubic inch of such a star might weigh up to 100 tons, indicate the ages of the clusters of stars in which they are found.

They tell ages because these rare stars are dying ones, the last visible stage in stellar evolution, Dr. William J. Luyten of the University of Minnesota reports.

He told a joint meeting of two local chapters of the Society of Sigma Xi in Pittsburgh that white dwarfs were discovered only about 40 years ago, and that their importance was becoming greater every year. He said finding such stars, which are no larger than a planet but with a mass nearly that of the sun, caused a minor "revolution" in astronomical thinking.

According to all theories current at that time, Dr. Luyten pointed out, this kind of star simply could not exist.

White dwarfs remained a mystery until the late Sir Arthur Eddington explained that they were matter in the raw — collapsed atoms.

Such stars provide a test for Einstein's theory of relativity, and allow the study of matter under conditions that cannot be duplicated on earth.

For the Home Lab

Tannic Acid

by Burton L. Hawk

➤ When an insect punctures the leaves or buds of certain trees, such as the oak or the sumac, there develops at this point a pathological growth which is known as a gall. These galls, or "tumors", sometimes grow to the size of a baseball. Some scientists have likened them to the cancer tumor in animals. The plant galls grow as a result of an insect egg or larva, and the cells within the galls serve to nourish the parasite.

Our chief interest here is concerning the material obtained from these galls: tannic acid, or tannin. Actually, there is a group of substances known as tannic acids. One type, related to the depsides, is obtained from the galls described above. A second type, related to diphenyldimethylolid, occur in certain nuts and pods. The third class, known as phlobatinnins, is obtained from wood, bark, leaves and from certain plants such as tea. All groups are amorphous solids and slightly soluble in water. All are polyhydroxylic phenols. All have an astringent taste and are easily oxidized, giving dark blue-black precipiates with ferric salts, which make them suitable for inks. All of them precipitate proteins from aqueous solutions, which make them useful in the leather industry by converting the protein of the hide substance into a tough, insoluble material.

The tannic acid of commerce is probably a mixture of these various tannic acids. For the experiments that follow, prepare a solution by dissolving about one gram of tannic acid in 50 cc. of hot water. This solution must be freshly prepared as it slowly decomposes on standing. In another container dissolve a few crystals of gelatin in 10 cc. of warm water. Add a few cc. of the tannic acid solution. Note the precipitate. It is this characteristic that makes tannic acid useful in the leather industry.

Tannic acid reduces *Fehling's Solution. To demonstrate, warm 5 cc. of tannic acid solution with a small quantity of Fehling's Solution. Note the precipitate formed. For another example, repeat the test using **Tollen's Reagent. Be sure to use a *clean* test tube. If your tube was clean enough, a silver mirror will be deposited on the walls. The tannic acid has reduced the Reagent to metallic silver.

Add tannic acid solution to solutions of lead acetate and copper sulfate and note the precipitates obtained.

Ink

The blue-black precipitate formed when tannic acid is mixed with ferric salts forms the basis of many inks. Add a solution of ferric chloride (or ferric ammonium sulfate) to tannic acid solution. Try writing with this mixture, using a clean pen. Now add a solution of pure ferrous sulfate to tannic acid solution. If your ferrous sulfate is pure, there should be no color formed. But if your ferrous sulfate is colored yellow or brown it has become oxidized and will not be satisfactory for this experiment. Dip a piece of filter paper in the colorless

mixture and allow it to dry in the air. Note that it turns blue as it dries. This blue color is the result of the oxidizing action of the air, which forms the ferric salt from the ferrous. Write with the colorless solution. The writing will be colorless at first but will gradually darken and become visible upon drying.

Add a solution of oxalic acid to your ferric-tannic acid ink prepared above. Note the solution becomes colorless. Hence, oxalic acid is useful as an ink eradicator or to remove ink stains.

If you want to make an "official" ink, here is a formula for Government Standard Writing Ink. Dissolve 5.85 grams of tannic acid and 1.9 grams of gallic acid crystals in 300 cc. of warm water in a flask. Add 1.45 cc. of concentrated hydrochloric acid and 7.5 grams of ferrous sulfate crystals. Stir and allow the solution to cool. In another vessel, dissolve 1.75 grams of soluble blue dye (Color Index No. 707) in 125 cc. of water. Filter, and add to the solution in the flask. Finally, add 0.5 gram of phenol (as a preservative), and enough water to make the total volume 500 cc. Mix thoroughly, let stand a few days; then filter. Bottle and stopper tightly.

Tannic Acid in Tea

As stated above, tannic acid is present in tea. Place a teaspoonful of tea in a flask and pour about 50 cc. of boiling water onto it. Allow to brew for about five minutes, then filter. Add a few drops of ferric chloride solution. Note the blue-black precipitate which forms indicating the presence of tannic acid.

If you wish you can use the above test to indicate the presence of tannic acid in oak or sumac bark. Boil the inner bark in water for a few minutes; then test with ferric chloride.

*Preparation of Fehling's Solution

Dissolve 3.5 grams of pure copper sulfate crystals in 100 cc. of water. This is Solution No. 1. Dissolve 17 grams of sodium potassium tartrate (Rochelle Salt) in 20 cc. of warm water and add a solution of 5 grams of sodium hydroxide dissolved in 20 cc. of water. Cool, and dilute to a volume of 100 cc. This is Solution No. 2. The solutions are kept separately and mixed in equal volumes immediately before use.

**Preparation of Tollen's Reagent

Place 2 cc. of a 5% solution of silver nitrate in a thoroughly clean test tube and add a drop of 10% sodium hydroxide solution. Now add a 2% solution of ammonium hydroxide, drop by drop, with constant shaking, until the precipitate of silver oxide just dissolves. This Reagent must be freshly prepared before use. It should *not* be stored under any circumstances. Upon standing, the solution decomposes and a highly explosive precipitate is formed.

√ Answers to CHEMISTRY QUIZ on Page 10. √

A - 2; B - 1; C - 2; D - 3; E - 2.

Amateur Rocketry Blasts Off

by ALLEN LONG

Amateur rocketry is gathering momentum even while trying to shake off the black eye it got after Sputnik. A growing corps of intrested youth are mining it for knowledge. Help, so far rather scarce, may be around the corner. Efforts at establishing a National program are in the works. There are even two bills before Congress aimed at helping amateur rocketeers.

➤ EFFORTS are under way in several circles to help the nation's estimated 10,000 amateur rocketeers pursue their hobby safely.

Two bills now awaiting Congress' consideration at the next session are aimed at strengthening amateur rocketry in the U. S., and in encouraging more of America's youth to study this complex science.

One bill, H. R. 8334 introduced by Rep. David S. King of Utah, proposes authorizing the building of safe and adequate static test stands and rocket ranges with associated equipment in each of the 50 states, to be operated under supervision of the National Aeronautics and Space Administration.

The bill calls for a collateral program and instructional staff "capable of providing those participating in the program with the education and training in rocketry and related fields that is required in order to insure that amateur rocketry in the U. S. will make the maximum possible contribution to scientific development of the nation with its resultant strengthening of the national security."

The other bill, H. R. 8493 introduced by Rep. Victor L. Anfuso of New York, calls for establishment of a Space Cadet Corps. This would be aimed at promoting development of rocketry and practical experience in astronomy, astronautics and related subjects. It would provide personnel for systematic observation and study of satellites and other celestial phenomena, and assist in getting college scholarships for its members.

"The Space Cadet Corps to be created by this bill," said Rep. Anfuso, "would encourage and help the young people of the country to take an active part now and eventually to find careers in the space sciences and practical astronautics. In order to meet the challenges of the space age, we need the fullest and earliest possible participation in space activities by our youth."

Both bills were introduced late in the last session of Congress. They indicate, at any rate, that amateur rocketry may be recovering from the "black eye" it got shortly after the Russians sent up Sputnik I.

The sudden glamor of orbiting satellites and pioneering the exploration of space appealed to many of the nation's youth. As a result, many young men, some of them adults, rushed in to build and blast off hobby-type rockets. Many paid for their ignorance in this treacherous field by being maimed or killed in mishaps.

Resulting publicity gave amateur rocketry a black eye, in the opinion of many experts. But the publicity also drew attention to the fact that rockets are dangerous playthings, that special facilities are required for safe launchings, that real experts are not only scarce but also sorely needed to guide neophytes, and that some sort of an organized program could be profitable not only to the enthusiasts but also to the nation.

The Department of Defense, one of the first to take a stand, issued a directive in June, 1958, requesting all departments to "cooperate with individuals and groups whose activities are dedicated to bona fide scientific pursuits." But it specifically disclaimed responsibility for "amateur experimental projects."

Wording of the directive more or less excludes rocket firings for the "fireworks" of it only, and limits even serious rocket experiments to bases having adequate facilities, such as the Atlantic, Pacific and White Sands Missile Ranges.

The Army, however, issued its own directive, which effectively opens Army bases, at the discretion of the commanding general, for firings of rockets which "have no new or unusual features, but which do serve to stimulate the interest of the nation's youth in scientific and technological matters."

Sporadic efforts to organize some sort of a program for amateur rocketeers have blossomed here and there, but as yet there is no real national program. Long before Sputnik some serious amateur rocket clubs existed in the U. S., and worked with admirable safety records for years. Recently a number of proposals have been made to put amateur rocketry on a national basis. Among them is a proposal by Col. Ken Hoyt — who founded the Civil Air Patrol during World War II — to make the study of rocketry a function of CAP training.

The American Rocket Society, meanwhile, was studying the matter. Appalled at the number of accidents, the ARS came out flatly against "any amateur experimentation whatsoever with rocket propellants or rocket propellant materials of any kind."

ARS published a 76-page report of its study and, alarmed at the impetuosity of youth, stapled two warnings to the cover admonishing the reader to keep the report away from minors because it contained lists of chemicals extremely dangerous in the hands of amateurs, and photographs of dangerous practices in rocket launchings.

The report pointed out that even graduate engineers view their creations, especially fuels, with cautious respect, and that there is good reason: aside from the possibility of an explosion during handling and mixing of fuels, the design of the rocket itself is explosively critical. The balance between pressure developed by a burning fuel and the structural strength of the rocket is extremely delicate. If the fuel is too weak, the rocket fizzles on its launch pad. If a little too strong, the rocket simply explodes. Developing just the right pressure is a tricky business that challenges even the most experienced expert, ARS points out.

But ARS does believe there are areas in rocketry in which amateurs can profitably work. None involve the "fireworks" aspect of rockets. Rather,

they probe the science of rocketry. They embrace such experiments as aerodynamic testing of rocket shapes in home-built wind tunnels, designing hydraulic systems, working out cooling systems for rocket engines (perhaps using a Bunsen burner as a laboratory heat source), and building equipment to telemeter acceleration data.

There is evidence that the superficial, flash-in-the-pan interest in rocketry is dying out. Many observers have noted a drop in the number of accidents reported by the press. They interpret this as meaning that many post-Sputnik enthusiasts have now lost interest, leaving the hard-core group which is sincerely and carefully pursuing rocketry as a scientific matter.

Perhaps a confirming barometer in the fall of amateur rocket interest was an observable drop in the number of rocket-type exhibits shown by teen-aged finalists in the National Science Fair this year.

It is believed that the remaining amateur rocketeers will help regain the good name that "amateur rocketry" held prior to the post-Sputnik rash of accidents and deaths.

Success of TB Vaccine

➤ CONTRADICTING the opinions recently expressed by U. S. experts that the B. C. G. tuberculosis vaccine was of little, if any, value, the British Medical Research Council has just made a progress report on a controlled clinical trial it has been conducting since 1950. The Council says, in a 20,000-word report, that it has proved vaccination against tuberculosis does prevent the disease in young people.

Nearly 57,000 children, aged 14 to 15½ years, living in different parts of England, were used in the tests. The tests were started nine years ago and many of the subjects are now young men and women. They have all been closely studied since they were first vaccinated. The reduction in tuberculosis attributed to vaccination which is given by injection is 83%.

The trial has been conducted by a team under the direction of Dr. P. D'Arcy Hart, with the co-operation of local health authorities. "These tests establish beyond question the value of vaccination for young people," Dr. Hart said. He added that protection had been shown to extend beyond adolescence into early adult life. It lasted for at least five years and perhaps six or more years. The potentialities of vaccine were even greater than had at first been thought.

The object of vaccination is to give a person a harmless infection which will confer immunity against a later virulent infection. Protection is still well worthwhile.

Although the number of deaths from tuberculosis has fallen remarkably in recent years, many cases of the disease are discovered yearly. Last year about 30,000 were notified in England and Wales.

Two vaccines have been used in these tests: the Bacillus Calmette Guerin, named after its discoverers in Paris more than 30 years ago, and

usually called B.C.G.; and a vole bacillus vaccine discovered by Dr. A. Q. Wells, of Oxford, England, who was a member of the investigating committee until his death in 1956.

The Wells vaccine proved superior even to B.C.G. During the five-year follow-up period, the annual incidence of tuberculosis in the B.C.G.-vaccinated group was 0.38 per 1,000. This compared with 2.29 per 1,000 in the unvaccinated group. This represented a reduction attributable to vaccination of 83%. The annual incidence in the Wells bacillus-vaccinated group was 0.33 per 1,000 against 2.62 in an unvaccinated group. This represented protection of 87%.

The British Medical Research Council conclude that "The present results show that a general vaccination scheme among children 14 to 15 years of age should reduce the number of cases developing between the ages of 14 and 21 by about one-half.

Water Hating DDT Poses New Problem

➤ DDT, ONE OF THE OLDEST and supposedly best known insecticides, hates water, U. S. Department of Agriculture scientists have just discovered.

This may help explain some of the strange results when mosquito control workers tried to use the insecticide on ponds, lakes and other mosquito-breeding areas. DDT is so hypophobic, or water-hating, that it "rushes to get out of suspension." It also tends to concentrate on the upper water surface and to cling to the walls and bottoms of containers, USDA entomologists and chemists report.

In laboratory tests as much as one-third of the insecticide had fled to the walls and bottoms of the containers within two minutes after stirring in one part DDT per 100,000,000 parts of water.

It made no difference whether paper, glass or aluminum containers were used. Within 24 hours more than half the DDT, long known for its persistence and non-volatility, had evaporated.

Field studies are underway to see if changes in application methods will lead to more effective results.

Space Dust in Planets' Atmosphere

➤ THE DUST PARTICLES of interplanetary space may be observed suspended in the atmospheres of the planets Mars and Venus.

Dr. Thomas Gehrels of Indiana University made this suggestion after studying the polarization of light from the two planets and the moon. He found the strongest polarization occurred in the ultraviolet.

This marked effect indicates that the reflected sunlight is being scattered by particles about a hundred-thousandth of an inch in diameter. Dr. Gehrels suggests that these particles may be of the same nature as the micrometeorites found in the earth's atmosphere, according to a report in the *Sky and Telescope* (Nov.), journal for astronomers.

Analytical Chemistry

by C. M. Gambrill

Condensed from the A.S.T.M. Bulletin

The place of the analytical chemist in modern industry has grown rapidly in importance. He is being asked to tackle ever more complex problems, but newer tools and techniques have multiplied his abilities. The technology is moving ahead at a rapid pace. "The research of today will . . . become the routine of tomorrow."

➤ Not too long ago the analytical chemist was somewhat the problem child of the laboratory. He was treated with something like enforced tolerance, and any discussions of research programs or plans regarding analytical work were seldom a part of his activity.

Sampling, and the use of the right analytical method were subjects of little concern until an error occurred or something else went wrong. The analyst frequently was confronted with unusual requests or with large sample loads but was given little or no background information as to what was actually needed. He was expected to analyze anything by the chosen method and to do it in the twitch of an eyelid, regardless of time, effort, and possible research that might be required. Too often, the chemist who wanted an analysis had more than one choice of laboratory to which he could submit his sample. There was the routine inspection laboratory, the chemical analysis section, and the instrumental or physics section. These were the three main divisions; if X-ray was available, this was another group which possibly could handle certain needs.

This is an abridgment of the Anachem Award Address presented by Mr. Gambrill at the Sixth Annual Conference of the Association of Analytical Chemists. Mr. Gambrill, analytical coordinator for the Research Laboratories, Ethyl Corp., is chairman of the Research Division on Elemental Analysis of ASTM Committee D-2 on Petroleum Products and Lubricants.

New Picture

The picture is quite changed today, at least in the larger laboratories. It is now generally recognized that analytical services should be integrated to obviate the practice of chemists or engineers shopping around to get their problems solved.

J. K. Roberts, director of the Standard Oil Co. (Ind.), has defined an analytical chemist as one who has "the ability to carry out analyses and be technically expert in so doing. Although he may not carry out all of the manipulation, he should be thoroughly acquainted with all phases of the work, recognize or evaluate unusual phenomena observed during the course of an analysis, and continually be aware of features of individual analytical methods which will limit or favor their use in particular cases. A broad knowledge of the many analytical methods and techniques must be at his finger tips. . . . Where no

suitable method is at hand, he should be capable of developing one. . . . A complementary requirement, often woefully lacking in the undergraduate applicant today, is the ability to report the results of his own work in concise and readable form. An additional asset is the ability to train and supervise non-technical people. The opportunities for the chemist with such talents are not often recognized outside the industrial laboratory."

Analysis today is a more complex business than ever before. Not only does a host of new materials or combinations of materials come out of the many research programs, but also more and more attention is being paid to the less common elements. To complicate matters further, more information is being requested by research people on smaller and smaller samples and lower and lower concentrations of components.

In Walter Murphy's editorial in the October, 1955 issue of *Analytical Chemistry,* he said, "To select the best and most economical analytical method requires an analytical department equipped and staffed with qualified personnel in all phases of analyses. When this is done, only an outline of the information required is necessary and the analytical group decides what is best to obtain the required information." It is this type of operation that builds the enthusiasm, initiative, and loyalty that makes for smoothly operating analytical units.

Organizational Changes

Now let's consider organization. Not very many years ago, analytical laboratories were nonintegrated units established to handle certain types of analysis. These groups often competed with each other on service problems and sometimes produced more harmful than beneficial data. This resulted either from lack of interest in the problem or from inadequacy of experience, background information, or development of methods. As the various types of instruments were improved and could be adapted to analytical service problems, the chemists took them over, and a gradual build-up of instrumentation within the chemical analysis group became evident. Instruments provided more rapid determinations, and more often than not gave more information than could be obtained by available chemical methods.

This shift in effort brought about a much needed fundamental change. The several analytical units were organized into one group to better coordinate the work. This placed the analytical group at a higher level in the organization and gave it greater status in the over-all operations of the laboratory. Consolidating the effort in this fashion improved the service to a great extent and, at the same time, brought the analyst into more prominence as an integral part of the research organization.

Coordination of operations is now an essential factor in the success of the analytical group. Good analytical work cannot be accomplished from an ivory tower. Given creative cooperation by the research workers, analysis can become the spark plug of progress rather than the well-known bottleneck.

Instrumentation

Now, let us consider how modern instrumentation has multiplied the analyst's abilities. Analytical chemistry

not many years ago involved primarily elemental analysis, with some work done on functional analyses in both inorganic and organic chemistry. The science of analytical chemistry was primarily the science of measurement applied to the relatively few chemical reactions that could be made to follow a stoichiometric equation. The ultimate in analysis was to take a sample and so analyze it that a total of 100 ± 0.2 per cent could be accounted for. The badge of success was the number of determinations that could be made on one sample by one chemist.

Broadening Field

Today, analytical chemistry involves all of the science of measurement. It involves the application of complicated instruments to complex systems without prior separation. Each quantity to be determined is measured on a separate sample without destroying the sample. Among the complex and automatic analysis tools is a mass spectrometer with a Sadic that types out the answer. Steel mills use quantometer spectrographs to record the impurity metals in a sample in the laboratory and transmit the answer to the furnace rooms at the same time. Direct-reading and controlling devices are the rule rather than the exception.

More recently, even more complicated solutions to difficult problems have been devised. One laboratory has worked out a computer program along with an infrared spectrophotometer so that the analysis is typed out when a card containing the spectrum is fed into the computer. The spectrum of the sample corresponds to the composite spectrum represented by analysis at 340 calibration points. With little more effort, 1000 points can be used. Furthermore, this application makes it no longer necessary to know the identity of every component in the mixture. If an extraneous impurity is present, the computer will type out the analysis and record a residual spectrum of the impurity to permit its identification.

Gas chromatography techniques — a laboratory curiosity five years ago — are today a major tool of the laboratory. Every day one hears of another advance in this rapidly growing technology, not only for analysis, but also for application to process controls.

Automatic X-ray fluorescence instruments are being developed for the analysis of steel and alloys of high atomic number elements. This technique, which permits analysis without sample destruction, may prove more accurate and more rapid than the presently available procedures. The method may have further application and advantages in the analysis of the new alloys being developed for high-temperature operations in this jet age.

Problems and Trends

What are some of the problems to be resolved and what are some trends? The development of rapid and inexpensive tests accurately to predict fuel performance is urgently needed. Until recently, it was no problem to supply motor fuels that satisfactorily met the requirements of automotive engines, and ratings at ± 0.5 octane number were adequate. The trend today to engines of higher compression ratio and the resulting need for fuels of 100-plus octane num-

ber make this task of fuel rating more difficult. The significance of improved engine ratings is quite evident when it is realized that existing tests are not adequate to predict ratings closer than ± 0.2 to 0.3 octane number; this degree of uncertainty costs the petroleum industry millions of dollars a year.

Of even greater importance is the need for a new test engine that will relate the octane number of a fuel to its performance in typical cars on the road. Stated in another manner, road ratings and laboratory ratings of fuels must be brought into closer agreement. For this purpose, improved instrumentation and more rapid rating methods are receiving considerable attention today. When it is realized that 75,000 ratings requiring approximately 30 to 60 minutes each are made each year, the savings in man-hours resulting from any improvement becomes significant.

Analysis for concentrations of contaminants at levels of parts per billion are now commonplace, and the extension of analytical techniques to lower and lower limits is the constant goal of the petroleum analysts. For example, feed streams to platformers now have to be carefully checked for contaminants at levels of 50 ppb for lead, 10 ppb for arsenic, and similar low levels for nitrogen and chlorine. Altogether, the problems are most challenging.

In an editorial entitled "New Analytical Methods Challenge Old Ones" in the February, 1958, issue of *Analytical Chemistry*, L. T. Hallet stated:

"Classical methods of determining elements or groups are based upon chemical reactions or decomposition under specified conditions. These methods, the results of years of research and testing by analytical chemists, are considered the standards by which all other methods are judged.

"Newer methods, based particularly on nondestructive physical approaches, are beginning to cast some doubt on the accuracy of some time-honored procedures. . . . More recent is the utilization of nuclear magnetic resonance as a nondestructive method for determining adsorbed water and water in the molecules. Infrared studies of functional groups are proving more accurate than some of the more conventional chemical methods. Viscosity measurements which differ depending on the method used have long been a controversial subject. Ultrasonic methods do not disrupt the system under study and so probably give a more accurate indication of true viscosity. When the validity of results obtained using the newer physical methods is proved, the physical methods will probably become the standards by which chemical methods are judged."

In Conclusion

During the next few years we can expect an increasing flow of new materials, new metallic alloys, and new machinery — developments coming out of long-established research programs of industry. Along with these developments, the analytical chemist will play his part in the development of new analytical techniques, new instrumentation, and new concepts to make these new products a reality. It is no wonder that the neophyte chemist has a rude awakening on graduating from qualitative and quantitative studies to the vast array of techniques and methods in this expanding field of analytical chemistry.

Coffee—Natural or Synthetic?

by Tove Neville

Coffee is the most popular beverage in the Western World. Its popularity has steadily spread since the 17th Century when it was a curiosity. Today it is grown the world over, but natural coffee may in the future be threatened by a synthetic product.

➤ The coffee break is almost as much a daily routine as is the rising sun, but if tomorrow's cup of coffee will be the natural brew or a synthetic concoction, only time can tell.

Although the synthetic coffee is still at the research stage, scientists are confident that it could go into production within a couple of years if only a sufficient amount of money were spent on research. Dr. Albert Zlatkis of the University of Houston has, by the process of chromatography, succeeded in separating 30 components, or parts, of the coffee flavor or aroma. He expects to find at least 50 different components, all of which can be produced very cheaply from common chemicals, such as acetone and corn chemicals.

The research so far completed by Dr. Zlatkis has involved only himself and one research assistant working for a few weeks. In a relatively short amount of time much was accomplished. Encouraging results: The mixture of the 30 components did not taste exactly like coffee, but it was similar. It is expected that when all 50 components have been found and reproduced chemically the result will be coffee flavor.

Now, why all this trouble about making a synthetic coffee? What about a new International Coffee Agreement which will cut coffee exports?

The coffee agreement was made among some of the leading coffee producing nations because coffee prices have gone down 50% the last three years. Fifteen Latin countries, Portugal, the French Community and the State of Cameroon agreed to export only as much coffee as each country had produced in the best year out of the last 10, minus 10%.

Still, in the laboratory, the scientists are trying to produce more coffee of a synthetic variety. What is the reason?

Originally the research on coffee flavor was begun in an effort to improve instant coffee. During the last 10 years, the consumption of soluble, or instant, coffee has increased steadily to an all-time high in 1958 when 3,600,000 bags of coffee were used in making the soluble variety.

The increased popularity of instant coffee must be accounted for by the fact that it is the quickest cup of coffee available. It is practical, fast and easy to make, and is especially suited to the national institution called the coffee break.

However, there is one drawback to the instant coffee. It does not have the full flavor of the brewed natural coffee. Unfortunately some of the flavor in instant coffee is lost in the dehydration process, it was reported lately by the Stanford Research Institute,

and it was because of this loss that aroma-research began.

But if the natural flavor can be reproduced so the instant brew tastes and smells like coffee, why add it to the instant variety which is already coffee? The next step would logically be to add it to a much cheaper substance, such as any kind of a roasted grain.

This is of course a possibility which has occurred to many, but the big question is: Will the synthetic taste like the real thing?

On this point there are various conflicting opinions. It seems that only the finished product will give the answer at the first synthetic coffee break. George Robbins of General Foods, New York, is not very optimistic that synthetic coffee will ever capture the real coffee flavor. He also thinks that stabilizing the flavor will be a difficult problem, and he predicts that the price of synthetic coffee will be higher than that of natural coffee.

Dr. Zlatkis, who headed the Houston team, believes the synthetic flavor can come pretty close to the natural one. At least, it can be approximated very closely, although it may not be exactly like natural coffee.

The synthetic components can be produced very cheaply, he says, and the stabilization problem can be overcome. Dr. Zlatkis sees an important use for the synthetic flavor as an additive to instant coffee, whether synthetic coffee is eventually produced or not.

If successfully and cheaply produced, a completely synthetic coffee will be another replacement of a natural food product by chemistry, just as the synthetic vanillin has largely usurped the place of vanilla from the natural bean. What the price of the finished product on the grocer's shelf will be is anybody's guess.

Even more important to consider are the economic repercussions a synthetic coffee selling cheaper than natural coffee might have on the coffee-growing nations.

In Latin America alone, where coffee is the most important commodity, 14 countries are dependent on the coffee consumption of the world. The Western Hemisphere now grows about 75% of the world's coffee.

The giant coffee industry had modest beginnings in the western half of the world. In the 17th century when coffee was first sold in England, it was described as a berry, growing on little trees only in the deserts of Arabia, which was boiled into a drink after being dried and ground to a powder. It was said to aid the digestion, quicken the spirit, and make the heart light, and it was considered a good remedy against dropsy and scurvy.

In the 18th century coffee became widely used in England, where it was drunk in the famous coffee houses where men of culture and learning gathered to discuss the current political developments or settle their disputes as to the latest literary and scientific theories.

The coffee plant was introduced to the Caribbean by the French and English and to South America by the Dutch early in the 18th century. The plant thrived so well that it soon became a general crop in all of tropical America.

Chemical Patents

To obtain copies of these new patents, order them by number from the Commissioner of Patents, Washington 25, D. C. Enclose 25 cents in coin, money order or Patent Office Coupons (but not stamps) for each patent ordered.

Eggs Make Tastier Instant Coffee

➤ FOUR INVENTORS have discovered that whole natural eggs may be used in producing "a soluble coffee concentrate of surprisingly improved flavor." They received patent No. 2,911,302, for an improved instant coffee prepared with an egg-containing solution.

The use of eggs in brewing coffee is an old household art that fell into general disuse in this country with the advent of improved mechanical brewing apparatus. Usually eggshells or egg whites were added to boiled coffee before pouring to improve the clarity of the beverage.

The object of this new method of Fletcher A. Chase, Morris Plains and Samuel Lee, of Fair Lawn, N. J., and Frederick D. Montgomery of Chicago, is to produce a better tasting instant coffee and to provide a process that will upgrade less desirable coffee types so that they may be used in making high-grade concentrate.

The eggs used in the process are fresh or fresh-frozen whole eggs minus the shells. The instant coffee of "improved flavor" is prepared by adding a small amount of hot, clarified, egg-modified solution of ground roasted coffee to a larger amount of cool concentrated solution of ground roasted coffee such as is customarily produced in the manufacture of instant coffee. The mixture is then spray-dried to produce a solid soluble instant coffee that may be packaged, sold and used in the usual way.

The inventors assigned one-half of their patent rights to William L. McLennan, doing business as North Woods Coffee Co., Chicago, and one-half to American Instants Inc.

Steel-Cladding Method

➤ A METHOD of cladding steel with corrosion-resistant metals, such as titanium and zirconium, won a patent for Frank C. Wagner of Cleveland. He assigned it to Horizons Inc., Princeton, N. J.

Because of their resistance to marine atmospheres and many acids, titanium and zirconium are very desirable metals for use as structural materials in many commercial applications. But their expense and short supply prohibit their extensive use. Successful ways of coating less costly and more abundant base metals, such as steel, with corrosion-resistant metals have therefore been sought.

A previous cladding method, involving diffusion bonding of the cladding layer to the base metal by means of a high-temperature, pressure welding operation, often resulted in an imperfect bond.

The bond was subject to rupture due to the formation of oxide films on the surfaces of the metals and the formation of brittle alloys of the two metals at the interface of the metals.

By Mr. Wagner's method, for which he received patent No. 2,908,969, the cladding metal is bonded metal such as chromium, cobalt or molybdenum.

The three layers are heated to a temperature of at least 1,400 degrees Fahrenheit in an inert atmosphere and compressed together. What results is a product in which the corrosion-resistant titanium or zirconium is firmly bonded to the steel base metal.

Method Classifies Diamonds

➤ A METHOD for examining and classifying diamonds that enables an examiner to detect and determine the amount of flaws won patent No. 2,909,961 for Albert S. Samuels, Sr. of San Francisco.

The classifying of diamonds is done by experts usually with the aid of a microscope. Detection of flaws, usually carbon particles or fissures causing opacities and translucencies in the otherwise clearly transparent substance of the gem, requires considerable knowledge and experience.

Therefore, it is almost impossible for the average gem purchaser to judge the value of a diamond, and many buyers are charged more than the gem is actually worth.

By Mr. Samuels' method, a photographic film is exposed to light that has passed through a diamond and a microscopic lens. This produces an exposure through the diamond that gives a record of its flaws. The film, inserted in a conventional slide mount, may be projected on a screen to enlarge greatly the image. In this manner, flaws are easily detected and measured so that a comparison can be made of the entire flaw area with the total area of the stone.

Thus, the purchaser of a diamond may be fully informed with mathematical accuracy as to the percentage of flaws in the stone. Also, the film may be preserved as a record by which the stone may be identified and appraised for insurance purposes.

Springs and Foam Rubber Fill New Tire

➤ AN AUTOMOBILE TIRE has been invented that is filled with nothing but springs and foam rubber.

It is claimed to be more practical and versatile than previously patented non-inflatable, spring tires, and earned for inventor Ray H. Alexander of Holdrege, Nebr., patent No. 2,912,032.

Mr. Alexander knows of no previous tire of this type that has received commercial acceptance. This, he says, is because many resilient, non-pneumatic tires are actually complete wheels that would have to be substituted for regular vehicle wheels. In other instances the performance, durability or appearance of these airless tires have not been satisfactory compared with conventional pneumatic tires, and repairs have often involved replacing a complete wheel unit.

Mr. Alexander's tire may be mounted on wheel rims, may be easily repaired and recapped, and has substantially the same appearance as current pneumatic tires. It is both durable and transmits little road shock.

The tire consists of an inner flanged rim and a continuous, flexible outer metallic rim. Numerous undulating strap springs extend between both rims. Between the springs is a foam rubber filler. An outer treaded casing is vulcanized to the outer rim and to the flanges of the inner rim.

Aerial Prospecting

➤ AN IMPROVED method of prospecting for minerals from the air has been granted a patent. At least two radiation detectors are flown simultaneously at different altitudes and at substantial distances from one another. Helicopters, airplanes, dirigibles and gliders may be used.

The instruments can detect ores having greater radioactivity than the surrounding rock, such as uranium and radium, and ores having less radioactivity than the surrounding rock, such as iron, copper, lead and zinc.

Previous techniques for aerial radioactivity prospecting have incorporated the use of one radiation detector. These give an indication of mineral deposits within only a relatively large area beneath the aircraft.

The new scheme, using several widely spaced detectors, overcomes this difficulty and pinpoints the deposits better.

The method was invented by Rex P. Mulligan, White Plains, N. Y., and has been assigned to Texaco, Inc. It earned Mr. Mulligan patent No. 2,904,691.

There are several configurations in which the prospecting aircraft could fly. A nairplane, dirigible or helicopter, for example, could carry one detector while towing another in a glider at a lower level. If desired, the aircraft need carry no detector but tow two or more in gliders.

Rocket Fuel Safely Stored

➤ A WAY to store liquid-fueled rockets safely aboard ship won patent No. 2,902,822 for James D. McKiernan, Brooklyn, N. Y., who assigned his rights to the U. S. Navy.

Mr. McKiernan's invention is designed to eliminate shipboard fire and explosion hazards, especially during rough weather.

He accomplished this by designing a liquid-fueled rocket that can be stored separately in two sections, but be quickly assembled when needed. The rocket consists of two cylinders, one which fits into the other. Each contains a fuel ingredient.

A gas-producing agent is packaged in the rocket nose. When ignited, a quick build-up of pressure forces the two fuels to break specially designed disks. Then the fuels mix in the nozzle, ignite and blast the rocket skyward.

Reliability of the rocket is enhanced by absence of fuel lines and mechanical pumps.

Rubber Types Identified

➤ A METHOD whereby rubbers of different degrees of unsaturation may be identified by the use of a radioactive zinc soap earned a patent for Alfred L. Miller, Cranford, N. J., Lester R. McNall, Los Angeles, and John Rehner, Jr., Westfield, N. J. They assigned patent No. 2,904,693 to the Esso Research and Engineering Company.

The process incorporates into the rubber to be identified a radioactively detachable amount of zinc soap.

Highly unsaturated rubbers, such as natural rubber, and rubbers having a low degree of unsaturation, such as butyl rubber, can thus be distinguished.

It is important to prevent accidental mixing of these two types because they are vulcanized differently.

Structural Change of Thyroid Molecule

➤ SCIENTISTS have successfully juggled the basic molecule of the thyroid so that it will do only the work desired, instead of producing a combination of good and bad effects. The effects of the thyroid hormone in man can now be separated by changing the structure of the basic molecule, six investigators explained at the annual meeting of the American Association of Physicians this year.

Now that the basic molecule can be changed, the effects of the hormone itself can be modified. For instance, thyroid hormone increases oxygen consumption by the body, lowers blood cholesterol and has a heat-producing effect. It also increases energy, mental alertness and appetite. Some of these effects are not needed in some patients, however. Others may even be dangerous.

For example, older patients frequently have a combination of low thyroid function and heart disease. If the usual thyroid hormone preparation is given to these patients, in addition to correcting the thyroid deficit, it raises oxygen consumption to a dangerous level in terms of heart condition.

If, however, a modified thyroid hormone is given, it produces all the needed effects without aggravating the heart condition.

Studies of more than 60 different variations of the thyroid hormone were first run using laboratory animals.

They produced a wide variety of biological effects, Drs. Rulon W. Rawson, William L. Money, Robert Kroc, Soichi Kumaoka, Richard S. Benua and Robert Leeper of the Sloan-Kettering Institute for Cancer Research and Memorial Center for Cancer and Allied Diseases, New York, reported.

N_2O_4 in Atmosphere of Venus

➤ NITROGEN TETRAOXIDE has been discovered for the first time in the atmosphere of the planet Venus.

Its presence there was detected from an examination of the sun's light reflected from Venus and spread out into its rainbow pattern of colors by a spectrograph at Georgetown University, Washington, D. C.

The compound has also been found in Jupiter's atmosphere, and the scientists reporting their Venus studies suspect that it is present in the atmosphere of Mars. Finding nitrogen tetroxide in a planet's atmosphere explains previous failures to detect molecular oxygen; the oxygen is locked away in chemical compounds.

No free oxygen has been found in the atmosphere of any planets of the solar system except earth, according to Dr. C. C. Kiess of Georgetown College Observatory. The studies of the spectrum of Venus were made by Dr. Kiess, his wife, Harriet C. Kiess, and Father F. J. Heyden, director of the Georgetown Observatory. Their observations were reported in the journal *Science* (Oct. 30).

They found a wide, continuous ab-

sorption band in the violet and ultraviolet region of the Venusian spectrum between about 4,500 and 3,800 angstroms. This structureless band is virtually "identical" with that produced by nitrogen tetroxide gas.

The presence of nitrogen tetroxide on Venus may also account for the color effects, when that planet's atmosphere appears not pearly white, but yellow, when seen through a telescope. Their studies were made with the support of the U. S. Army Engineers at Fort Belvoir, Va.

Strong New Plastic Challenges Metals

➤ A TOUGH, resilient plastic that will substitute for many metals has been developed. It is called Delrin and is the product of Du Pont scientists.

Plastics have previously not been strong enough to compete with metals in many applications. Now, Delrin promises to be usable for car door handles, dashboards of cars, fuel pump and carburetor parts, and showerheads. Over 75% of its potential applications, which number more than 500, involve replacement of steel, brass, aluminum and zinc.

The reason for Delrin's excellent properties lies in its chemical structure. It is formed from formaldehyde, a relatively simple molecule. The formaldehyde is polymerized, or joined together in long, tightly-packed chains. These unbranched chains form into very dense crystals giving the plastic its strength and unique ability for long wear.

The first usable polymer of formaldehyde that has been developed to any great extent, Derlin is being commercially manufactured by E. I. du Pont de Nemours & Company. It required 300 man-years of experimental work to develop a stable form of the polymer, and the development costs exceeded those spent by the company to produce nylon.

Delrin cannot replace metals completely, however. It cannot be easily cemented, and is discolored by ultraviolet rays, a characteristic of most plastics. Whether Delrin will be practical for very large shapes is not yet known. A garbage can liner is the largest thus far successfully made and tested.

Many companies are already extremely interested in Delrin as a metal replacement, and polyformaldehyde seems to be on the brink of assuming considerable industrial importance.

Threat Seen in Solar Radiation

➤ A SERIOUS THREAT to manned space flight has been discovered — very intense radiation thrown out by the sun during its active periods.

This new radiation makes the hazards of the Van Allen radiation belts, first found by earth satellite instruments, seem pale by comparison. A high level of 10,000 times normal has been measured on one occasion.

The over-all disturbed period, when the ionizing radiation exceeds normal background, lasts from one to eight days.

When one of these solar radiation events occurs, an individual in space within the solar system might be exposed to radiation totaling as much as 1,000 roentgens an hour. Thirty minutes of such exposure, would result in a dosage fatal to about half the persons so exposed, according to currently accepted tolerance rates.

During the past few years, this radiation has been observed using different methods by scientists at the State University of Iowa, the University of Minnesota and the Geophysics Institute of the University of Alaska.

At the time of a giant solar flare last May 12, the Minnesota group launched several simultaneous unmanned balloon flights. These revealed a tremendous burst of protons, or hydrogen nuclei, from the sun, resulting in unexpectedly high amounts of this radiation at balloon altitudes in the earth's atmosphere.

Drs. E. P. Ney, J. R. Winckler and P. S. Freier of the University of Minnesota propose that discovery of this radiation may impose the most serious threat yet to manned space flight.

In the Naval Research Reviews (Oct.), Malcolm D. Ross of the Office of Naval Research warns that manned space flight is not the next logical step following the recent Russian moon rocket feats.

Although shielding is an obvious solution to the problems presented by the "soft" solar radiation, he points out that the amount of material required for adequate protection will impose a "severe weight penalty and may not be a practical" solution.

"We must face facts regarding manned space flight," he reports. "Technical problems can and will be solved as they occur.

"The major new radiation discovery, however, is a recurring natural solar phenomenon, the result of a mechanism and events on the sun" not completely understood.

Since its occurrence cannot be forecast at this time, predictions of manned space flight in the near future appear "quite unrealistic," Mr. Ross concludes.

Brain Sensitive to Radiation

➤ THE BRAIN, once thought to be resistant to radiation, now appears to be radiation-sensitive. So report Drs. Thomas J. Haley and H. Gangloff of the nuclear medicine department of the University of California Medical School, Los Angeles.

The investigators exposed experimental animals to radiation at dose levels of 200 and 400 roentgens (a standard radiation unit of measure). The 400 r level can lead to a 50% death rate, but the 200 r level is not normally fatal and results usually only in some radiation sickness.

Electroencephalograph (brain wave) recordings and other observations were made immediately following radiation exposure. Marked spontaneous abnormal electrical activity was noted in certain brain areas at both dose levels. Transitory inability to sleep occurred shortly after radiation exposure.

It had been thought previously that brain cells were among the most re-

sistant type of cells to radiation effects. The UCLA observations are among the first in this country indicating such marked sensitivity of brain cells to radiation. (Some Russian scientists had previously suggested it.)

These results suggest that even relatively low level radiation belts (that is, with dosage levels around 200 r) may pose a problem to space crews and troops under tactical nuclear weapons fire.

Spontaneous brain electrical discharges and insomnia resulting from radiation effects might make them temporarily incapable of performing their duties.

Copper Oxide Might Reduce Smog

➤ COPPER OXIDE is a "highly effective" catalyst for breaking down and thus eliminating the two gases that produce most of our smog.

This is the finding of a two-year laboratory experiment by Dr. Srinivasa Sourirajan, assistant research engineer at the University of California, Los Angeles. Dr. Sourirajan's home is in Bangalore, India.

The smog gases are (1) nitric oxide, formed during combustion, and (2) hydrocarbons, which make up gasoline. In the main, they are emitted by auto exhaust when air and gas mix in a car's combustion chamber.

However, when nitric oxide is decomposed by copper oxide into nitrogen and oxygen, and hydrocarbons oxidized into carbon dioxide and water, both gases lose their polluting properties.

During his experiments, Dr. Sourirajan tested a large number of possible catalysts in a simulated auto exhaust system, at temperatures ranging from 600 to 1800 degrees Fahrenheit.

His next project is to design the apparatus which can actually put the copper oxide catalyst to work in an automobile's combustion chamber. The same catalytic method can be used to cut down the gaseous pollutants from oil refineries, or any combustion process, he points out.

Dr. Sourirajan's research is supported by a State of California grant, and he is assisted by two graduate engineering students, Jack Blumenthal and Mauro Accomazzo.

Synthetic Rubber Latex

➤ A NEW synthetic rubber latex said to be 100% replacement for natural latex in foam rubber has been developed. The man-made latex, known as Pliolite 5352, is capable of producing a premium foam rubber to meet the high cushioning standards set by automotive, furniture, mattress and other manufacturers without blending in natural or other synthetic latices. Developed by the Goodyear Tire & Rubber Company, the new material is claimed to be closer to natural latex than any other synthetic latex. There are also indications that it can replace natural latex in other areas besides foam, where, until now, only the natural material could be used.

New Drug Helps Skin Infections

▶ A NEW antibacterial drug has proven highly successful in treating almost 90% of patients with a wide variety of skin infections.

The new orally administered drug, whose generic name is furaltadone, is the newest of the synthetically derived nitrofurans, distinct from the antibiotics and the sulfa drugs.

The drug was effective, reported Dr. Alfred L. Weiner of the University of Cincinnati's College of Medicine, in treating 35 out of 40 patients with boils, carbuncles, bacterial skin infections accompanying eczema, acne, cellulitis, and other infections caused by staphylococci.

Besides the 40 patients whose progress was followed carefully, an additional 22 were treated in the short time his investigation has been underway. Initial study of this group indicates that results will probably parallel those obtained with the first group of patients.

Such skin infections are one of the most common problems caused by staphylococci resistant to antibiotics, and the incidence of staphylococcal infections being carried from the hospital to the home is on the increase, recent studies have shown.

The incidence of side reactions to the new drug was low, Dr. Weiner reported, with five instances of nausea and vomiting, one of dizziness, and an unusual reaction of rash, fast pulse and difficult breathing in a few patients who had taken alcohol during the drug therapy.

Resistors Made on Glass with Sputtering Method

▶ RESISTORS for electronic circuits can be put on glass or ceramic plates using a technique known as sputtering. Resistors are devices used to limit flow of an electric current.

D. A. McLean of Bell Telephone Laboratories told the Western Electronics Conference meeting that each resistor can be a line as thin as one one-thousandth of an inch. This shrinking of the size of resistors promises further reductions in the size of some electronic equipment, he said.

In the sputtering technique, ionized gas molecules bombard a metallic cathode. They dislodge atoms of metal which then redeposit on nearby surfaces. By depositing copper on a plate of glass, etching out the pattern wanted, sputtering on tantalum, then putting the plate in an etching bath, Bell engineers were able to produce fine lines of tantalum which can act as resistors.

In one experiment, a circuit occupying a standard printed circuit card three and one-half by seven inches in size was reduced to a ceramic square only two inches on a side.

One of the most important aspects of the development, Mr. McLean said, is production of capacitors and resistors from a single metal, complete with interconnections, to remove one of the greatest reliability hazards in miniaturized electrical circuitry.

Electron Transfer in Drugs

➤ How EASILY a drug gives up its electrons may be a very important factor in how good a drug it is.

Chlorpromazine has striking biological activity, a team of researchers reports in *Science* (Oct. 30). The drug, which affects the central nervous system, also has striking properties as an electron donor.

Chlorpromazine's tranquilizing action may be due to its charge-transfer properties, report Dr. G. Karreman of the Eastern Pennsylvania Psychiatric Institute, Philadelphia, and Drs. I. Isenberg and Nobel Prize winner A. Szent-Gyorgyi of the Institute for Muscle Research, Woods Hole, Mass.

Another drug, d-lysergic acid diethylamide, with strong action on the central nervous system was found to be a very good electron donor.

Further studies on charge transfer may contribute to understanding of the mechanism of normal and abnormal psychic functions, the scientists conclude.

Strontium-90 Level Soars

➤ SAMPLES OF alfalfa hay grown in Minnesota and South Dakota have been found to contain more than 10 times the maximum permissible level of strontium-90.

These figures, and others, were released by the Department of Health, Education and Welfare. They are based on samples tested in October of last year. Other samples of strontium-90 levels revealed that alfalfa hay grown in Nebraska contained one and one-half times the permissible level, and almost eight times the permissible level in Maryland.

Samples of the beta radioactivity of alfalfa hay and ensilage were studied in 19 states. Only the above four were studied for their strontium-90 count. The counts of the other samples remain unknown.

The maximum permissible level of strontium-90 has been set at 80 micromicrocuries per liter or kilogram in the entire diet over a lifetime. This standard was set by the National Committee on Radiation Protection and Measurements. Health officials, however, expressed the belief these newly detected high levels are not dangerous. Available evidence indicates that the amount of strontium-90 appearing in milk is considerably less than the amount of strontium-90 in the cow's diet. Yet, health officials say they do not know exactly how much of the dangerous isotope travels to the milk and meat of the cow.

When asked about foods that are grown in these areas and consumed directly by humans, Food and Drug physiologist Dr. Edwin Laug said that normal processing, that is, washing and blanching of vegetables, should remove most of the radioactivity.

However, the exact amount that is removed by this method has not been determined. The U. S. Public Health Service plans to examine the radioactivity of 473 samples of 50 varieties of food throughout the country.

Proudly Presented

Introducing New Developments and New Literature in the Chemical Field

New Data on Textile Chemicals from Carbide

➤ A NEW 44-page booklet, describing more than a hundred chemicals for the textile industry, has been published by Union Carbide Chemicals Company, division of Union Carbide Corporation.

The booklet contains application, formulation, and physical property data for textile chemicals used in 41 textile processing operations. Applications discussed in detail in the booklet are: adhesives for bonded fabrics; after-treating agents for dyeing; anti-creasing agent intermediates; anti-foaming agents; anti-fume agents; anti-slip finishing agents; anti-static agents; bleaching assistants; carbonizing agents and assistants; conditioners; corrosion inhibitors; detergents and assistants; dispersing agents; dyeing assistants; emulsifying agents and assistants; fiber synthesis and modification agents; finishing agents; fumigants; kier-boiling assistants; lubricants, mercerizing assistants; mildew preventives, mordants; paint and tar removers; plasticizers for flexible sizes, coatings, and finishes; printing assistants; reducing agents; resin intermediates; resists; sequestrant intermediates; shrinkage control agents; sizing agents; softeners; souring agents; stiffeners; stripping agents; thickeners; warp sizes; water repellents and ingredients; and wetting agents.

Talanta Medal

➤ THE BOARD OF EDITORS of TALANTA, a leading international research journal in the field of analytical chemistry, have announced a new award to be known as the Talanta Medal.

The publishers, Pergamon Press, are providing the funds for this Medal which will have a value of $300.00, and which will be awarded for outstanding contributions to analytical chemistry. The Medal will not normally be awarded more frequently than once a year, but no attempt will be made to award it at any stated intervals.

This Medal may be awarded either to analytical chemists who are responsible for major developments in the subject or to scientists whose work is judged to have contributed in a substantial way to the developments in the field of analytical chemistry.

New Dual-Purpose Automatic Labwasher

➤ A NEWLY designed, fully automatic Dual-Purpose Labwasher unit complete with built-in washing-rinsing-drying brain for spotless cleaning of all types of lab glassware has been perfected by The Chemical Rubber Co.

The new Dual-Purpose Labwasher's major features include: optional distilled or tap water rinses; automatic or manual operation of wash, rinse and drying cycles; corrosion-resistant pumping system; free-sliding washing compartment for convenient top loading and continuous working surface.

The basic advantages of this new

unit are (1) optional distilled or tap water rinses, (2) complete control of washing, rinsing, drying cycles through the selection of either automatic or manual control. Both are advantageous and essential in efficient handling of specific glassware washing requirements. These basic advantages now contribute to more economical laboratory programming and the higher rate of analysis productivity that results.

New Chemical Industry Facts Book

➤ Now AVAILABLE, the 1960-61 edition of The Chemical Industry Facts Book has been revised, up-dated and expanded. Included are new chapters on food, shelter, and space written to keep pace with the industry's constantly broadening contributions to the many facets of a highly technological age.

The book contains a wealth of current factual information on the industry's contributions to the economy, its plants and workers, its past and future, its research and development. Special chapters highlight the industry's role in the maintenance and improvement of health, in producing more and better crops, in contributing to more attractive, longer-wearing clothing, in helping create improved materials for better transportation and faster communications, and in the nation's defense and nuclear energy programs.

New Borden Catalog

➤ A NEW 36-page two-color product catalog and directory is being offered by Borden Chemical Company. The catalog lists specifications, end-uses, and other technical data for the more than 1000 products manufactured and distributed throughout the world by the company.

Borden Chemical industrial and consumer products are reviewed in the general areas of basic chemicals, monomers, polymers, resins, adhesives, coating materials, plastic products, fine chemicals, organic intermediates, and bio-chemical reagents.

The new publication also lists the company's sales and service centers throughout the United States, its 17 plant locations, warehouse points, and eight overseas manufacturing subsidiaries located in Argentina, Australia, Brazil, Canada, Colombia, England, Mexico, and The Philippines. The directory is cross-indexed by product name and end-use.

For a free copy write Department H, The Borden Chemical Company, 350 Madison Avenue, New York 17, N. Y.

New Hydrogen-Nitrogen Generator

➤ HAMLER-LEWIS, Limited, Chicago, and North American Philips Company, Inc., Cyrogenics Division, Mount Vernon, N. Y., will cooperate in marketing the new Norelco Ammonia-Gas Separator, according to a joint announcement by the two companies.

Philips is responsible for the development and production of the new machine and Hamler-Lewis will sell and install the equipment in some of the major industrial centers in the United States.

The Norelco Ammonia-Gas Separator incorporates unique design principles and employs a super cold refrigerator developed by Philips to pro-

vide compact machines that produce high purity hydrogen and nitrogen gases at low cost. This development makes oxygen-free and hydro-carbon-free hydrogen readily available from dissociated ammonia for use as needed.

The new systems besides eliminating problems which are frequently encountered when municipal authorities prohibit or severely restrict deliveries of hydrogen from outside sources, also provides a high purity product. In-plant hydrogen production also avoids storage difficulties which can involve serious contamination problems due to container corrosion.

New Polypropylene Plant

➤ HERCULES Powder Company has disclosed that it will build a multi-million dollar polypropylene plant at Lake Charles, Louisiana, designed for ultimate capacity in excess of 100 million pounds a year.

This will be the second Hercules plant for the production of polypropylene. The first Hercules plant, which was also the only commercial polypropylene plant in North America for a year-and-a-half, and one of the largest in the world, has been in operation at Parlin, New Jersey, since the latter part of 1957.

Construction of the new and larger facility will get underway immediately, with completion of the first 50-million-pound unit scheduled for early 1961.

Albert E. Forster, president and board chairman of Hercules, said the company's decision to expand polypropylene capacity was based on a widespread market acceptance of polypropylene for use in film and fiber, as well as injection-molded plastics items.

"Pro-fax," trademark for Hercules polypropylene, was developed at the company's Research Center near Wilmington, Delaware, only three years after it began work on high-density polyethylene.

Perhaps no recently developed plastic has gained commercial acceptance in so short a time as has "Pro-fax." It ranks today as industry's most promising and fastest growing plastic.

The lightest in weight of all commercial plastics, "Pro-fax" also has outstanding heat resistance, chemical resistance, impact strength, and rigidity in thin wall sections.

In addition to its use in scores of injection-molded articles, "Pro-fax" is being used to make rope, auto seat covers and outdoor furniture webbing, and in textiles. Extensive development work also indicates a big future in packaging film.

The light weight of "Pro-fax" is an important economic factor, which gives an extra yield per pound of material that provides significant cost savings over other plastics in the same price range.

New Material for Electrochemical Anodes

➤ A NEW MATERIAL for electrochemical anodes, titanium plated with a thin film of platinum, was demonstrated at the 27th Exposition of Chemical Industries by the Crucible Steel Company of America. Crucible, a pioneer producer of titanium, visualizes many uses for these anodes, the largest potential use being the replacement of graphite anodes in chlorine-caustic cells.

By coating titanium with platinum, less than 1/10,000 inch thick, titanium can be made to act like a solid platinum anode. Crucible believes this will prove valuable in cathodic protection, electroplating, control devices and in many electrochemical processes.

This novel anode may find large scale use in the chlorine-caustic industry because it will provide a maintenance-free cell. Present graphite anodes are consumable-type and are consumed during operation of the cell. This causes expensive tear-down of cells, results in higher operating voltages and leads to contamination of the chlorine. This new composite titanium-platinum anode eliminates these disadvantages and appears to provide savings in anode cost per ton of chlorine produced.

New Celanese Acrylate

➤ CELANESE Chemical Company have announced that it has started commercial production of 2-ethylhexyl acrylate at its recently expanded Pampa, Tex., plant. The new Celanese product is an addition to the company's line of acrylate monomers, which includes methyl acrylate, ethyl acrylate and butyl acrylate, all of which are manufactured by a unique process giving extremely high purity.

2-ethylhexyl acrylate and the other acrylate monomers are used in the manufacture of polymers for the paint, textile and paper coatings and adhesives fields. Acrylate monomers are currently used in large quantities and are among the fastest growing monomers utilized in the coatings industries. Other monomers produced by Celanese include vinyl acetate and vinyl propionate.

Ni Prevents Corrosion

➤ DEVELOPMENT of a new motor oil additive which employs nickel for the first time as an agent to prevent wear and resist rust and corrosion has been announced by Sinclair Research Laboratories, Inc. at Harvey, Illinois.

Unique properties of an oil soluble nickel compound were discovered more than four years ago. Since then that additive has been subjected to continuous laboratory study and exhaustive automotive fleet tests.

"The results of these tests," said W. M. Flowers, President of Sinclair Research, "show that we have perfected a revolutionary additive which impedes wear of moving engine parts and fights rust and corrosion to a degree heretofore unattainable in motor oil."

Flowers said that the nickel molecules, in an amazing way not yet fully understood by scientists, find their way and adhere to only those parts of an engine subject to erosion by high temperature and severe pressure.

New Solvent by DuPont

➤ DU PONT is now producing dimethylacetamide, a new polar solvent, in commercial quantities. This is the first time it has been made available for general industrial distribution.

Dimethylacetamide is similar to dimethylformamide but has a higher boiling point and other individual characteristics that set it apart.

The new product is colorless, and covers a wide range of solubilities for both organic and inorganic materials. It is miscible with water and most other solvents, and has good thermal and chemical stability.

Chemistry Comments

Interesting facts in the chemical world.

➤ Trace substances in the atmosphere may occur as gases, liquids or solid particles.

➤ Meat consists almost entirely of proteins — giant molecules, 1,000 to 100,000 times as large as table salt molecules.

➤ Copper was reduced from ore by smelting before recorded history, and tin before 3500 B. C.

➤ During 1959, demand in this country for natural rubber will be about 40,000 tons over the supply.

➤ Some amino acids can be converted to vitamins within the body.

➤ One ounce of cottage cheese has only 27 calories, compared to about 100 in one ounce of whole milk cheese.

➤ The fatty acid generally regarded as of greatest single nutritional importance is linoleic acid.

➤ A diet high in phosphates is the apparent cause in reduction of tooth decay by 50% in a year-long test among Scandinavian school children.

➤ About $100,000,000 will be spent on cancer research in the U. S. this year.

➤ Doses of epsom salts have been used effectively on apple trees as sprays for temporary relief of magnesium deficiency.

➤ As of June 30, 1959, there were 23 uranium processing mills in operation in this country.

➤ Quartz crystals lacking the uniform high quality that would qualify them for electronics use have potential uses in lapidary work for costume jewelry or as seed material for synthetic crystal production.

➤ The modern usage of nickel alloys for coinage purposes dates back to 1850.

➤ Scientists have learned from Egyptian mummies that diseases of 3,000 years ago are essentially the same ones that are present today.

➤ Meteoric iron, containing from five to 26% nickel, was used for knives, axes and other implements as early as 4,000 B. C.

➤ The Government has spent more than $750,000,000 in the past decade on harnessing the atom for the production of power.

➤ Proteins of animal origin from meat, fish, poultry, eggs and milk are high quality or complete proteins, whereas plant proteins are of lower quality and should be served in combination with animal proteins.

➤ Tin cans consist of a steel base covered by a very thin layer of tin ranging from 15 to 60 millionths of an inch in thickness.

➤ Nickel-plating was originally developed in England in 1843.

➤ United States reserves of uranium ore were estimated to total 88,900,000 tons on July 1, 1959.

Book Condensations

A Guide-book to Biochemistry — Kenneth Harrison — *Cambridge Univ. Press,* 150 p., $3.50. Short introductory text.

Experiments and Problems in General Chemistry — A. W. Laubengayer — *Rinehart,* 311 p., illus., paper, $4.50. Laboratory manual and problem book.

The Challenge of Chemistry — O. A. Battista — *Winston,* 167 p., illus. by Gil Cohen, $3.95. Future careers in chemistry.

Handbook of Chemistry and Physics: A Ready-Reference Book of Chemical and Physical Data—Charles D. Hodgman, Robert C. West and Samuel M. Selby, Eds. — *Chem. Rubber Pub. Co.,* 41st ed., 3472 p., $12.

Studies of the Hydrogeneation of Ethylene Over Copper-Nickel Alloys — W. Keith Hall and P. H. Emmett — *Mellon Institute,* 9 p., paper, free upon request direct to publisher, 4400 5th Ave., Pittsburgh 13, Pa.

Advances in Catalysts and Related Subjects, Vol. XI — D. D. Eley, P. W. Selwood and Paul B. Weisz, Eds. — *Academic,* 384 p., $12.50.

Principles of Dairy Chemistry — Robert Jenness and Stuart Patton — *Wiley,* 446 p., $8.75. Textbook.

The Determination of Particle Size by Adsorption Methods — R. Jay Fries — *Mellon Institute,* 18 p., illus., paper, free upon request direct to publisher, 4400 5th Ave., Pittsburgh 13, Pa.

Photooxidation of Hydrocarbons in Mixtures Containing Oxides of Nitrogen and Sulfur Dioxide — E. A. Schuck and G. J. Doyle — *Air Pollution,* 104 p., paper, $3.

An Introduction to the Organic Chemistry of High Polymers—Carl S. Marvel — *Wiley,* 82 p., $4.50. For beginners in polymer research.

Principles of Mineralogy — William H. Dennen — *Ronald,* 429 p., illus., $7.50. Uses minerals as examples for a study of geometrical, chemical and physical relationships of matter.

The Chemical Industry Facts Book 1960-61—*Manufacturing Chemists' Assn.,* 4th ed., 163 p., illus., $1.25.

Introductory Chemistry — Lillian Hoagland Meyer — *Macmillan,* 2nd ed., 528 p., illus., $6. Simplified textbook for the non-chemistry major.

Geochemical Methods of Prospecting and Exploration for Petroleum and Natural Gas — A. A. Kartsev and others, English transl. edited by Paul A. Witherspoon and William D. Romey — *Univ. of Calif. Press,* 349 p., illus., $12.50. Comprehensive coverage of geochemical prospecting for petroleum in the Soviet Union, with detailed descriptions of methodology and results.

Uranium and Other Miracle Metals — Fred Reinfeld — *Sterling,* rev. ed., 128 p., illus., $3.95. Tells the general reader what uranium is, where and how it is being mined and how it is used in atomic energy, radioactive drugs, and other peacetime applications.

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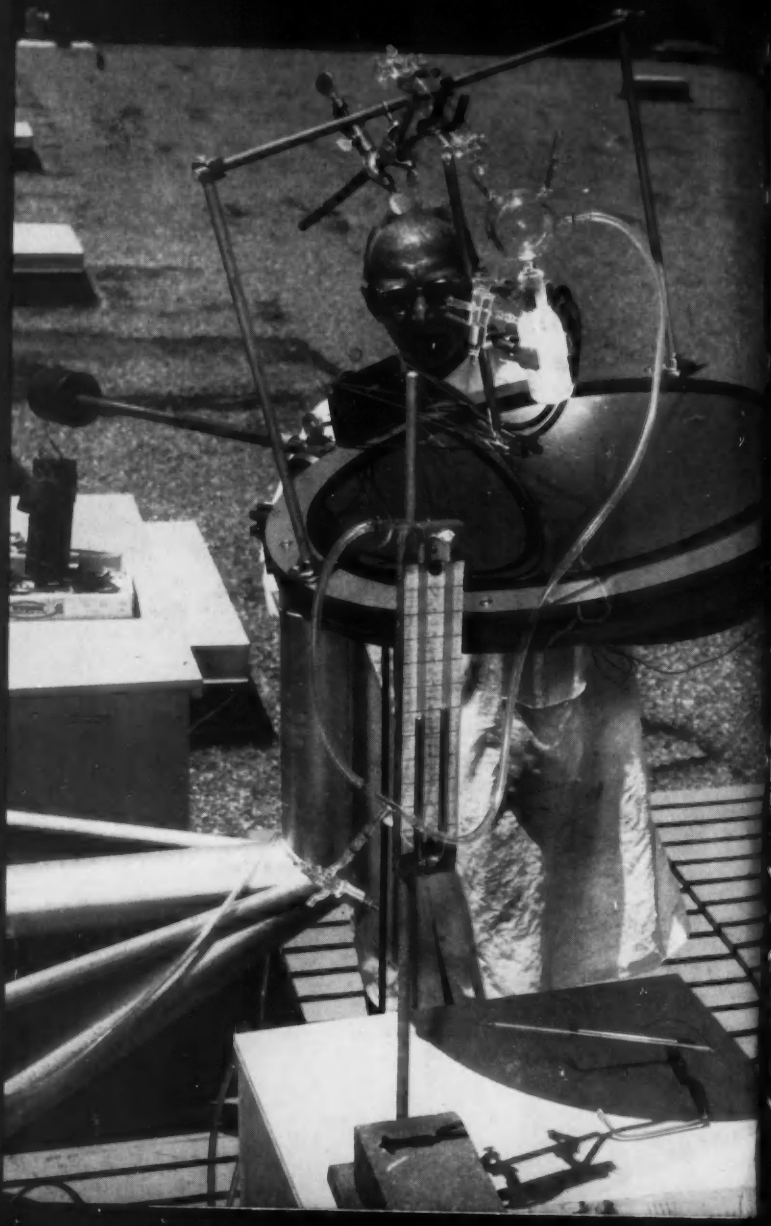
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